This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

B 1,295,158

BULLETIN

OF THE

UNITED STATES FISH COMMISSION.

VOL. VII,

FOR

1887.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1889.

JOINT RESOLUTION authorizing the Public Printer to print reports of the United States Fish Commissioner upon new discoveries in regard to fish-culture.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Public Printer be, and he hereby is, instructed to print and stereotype, from time to time, any matter furnished him by the United States Commissioner of Fish and Fisheries relative to new observations, discoveries, and applications connected with fish-culture and the fisheries, to be capable of being distributed in parts, and the whole to form an annual volume or bulletin not exceeding five hundred pages. The extra edition of said work shall consist of five thousand copies, of which two thousand five hundred shall be for the use of the House of Representatives, one thousand for the use of the Senate, and one thousand five hundred for the use of the Commissioner of Fish and Fisheries.

ADVERTISEMENT.

UNITED STATES COMMISSION OF FISH AND FISHERIES,
Washington, D C.

For the purpose of utilizing and of promptly publishing the large amount of interesting correspondence of the Fish Commission in reference to matters pertaining to fish-culture and to the apparatus, methods, and results of the fisheries, Congress, on the 14th day of February, 1881, by joint resolution (H. Res. 372), authorized the publication annually of a Bulletin, a portion of the edition to be distributed signature by signature, and the remainder in bound volumes. The present volume is the seventh of this series, and contains many announcements which are believed to be of great importance in relation to the subject in question.

MARSHALL MCDONALD,
Commissioner.

TABLE OF CONTENTS.

Page.

Bean, Tarleton H., 42. Report on the fishes observed in Great Egg Harbor Bay, New Jersey, during the summer of 1887 129

——. **54.** A hybrid between the Lake Trout and Brook Trout 216

(See, also, Collins, Bean, and Rathbun.)

Bissell, John H., 2. The Canadian and American Fisheries of the Great Lakes 7

Brakeley, John H., 6. Rapid growth of Carp due to abundance of food 20

Chalker, Robert B., 37. Catch of Shad in Connecticut for 1887 112

Chambers, W. Oldham, 5. American fish cultivated by the National Fish-Culture Association of England 17

Clark, Frank N., 20. Whitefish distributed from Northville and Alpena Stations 64

Cocks, Alfred Heneage, 35. The Finwhale Fishery on the Lapland coast in 1886 109

Collins, D. E., T. H. Bean, and Richard Rathbun, 55. Results of investigations by the schooner *Grampus*, on the southern mackerel grounds in the spring of 1887 217

Collins, J. W., 40. Notes on the use of Squid for food in the United States 127

——, **41.** Note on the occurrence of Mackerel off the coast of Florida 128

——, **60.** The beam-trawl Fishery of Great Britain, with notes on beam-trawling in other European countries, etc 289

——, **62.** Some reasons why the Fishermen of Nova Scotia prefer to use salt Clams (*Mya arenaria*) for bait in the bank hand-line Cod fisheries 425

——, **64.** Statistics respecting certain features of the Vessel Fisheries of the United States. 447

Dresslar, Fletcher B., and Bert Fesler, 63. A review of the Mackerels (*Scombrinæ*) of America and Europe 429

Duclos, Gilbert, 53. American Silver Perch or Calico Bass 215

Dunn, Horace D., 13. Fish-culture on the Pacific coast 49

——, **16.** Salmon not injured by Catfish 56

Earll, R. Edward, 56. Notes on certain Fishery Industries of Eastport, Me., in 1886 267

——, **and Hugh M. Smith, 46.** The American Sardine industry in 1886 161

Fesler, Bert. See Dresslar and Fesler.

Hamilton, W. R., 19. Croaking of the Perch 6

Hamlen, William, 36. Report on the Shad work of the steamer *Halcyon* during the season of 1887 111

Hinckelmann, Mr., 29. Injuries to the fisheries in the Baltic by Seals 8

Jordan, David S., 49. Note on the occurrence of the Opha (*Lampris guttatus*) on the Grand Banks 202

Layet, Alexandre, 31. Experimental hygiene. Observations on the red flesh of the Codfish 90

McDonald, Marshall, 34. Report of Shad distribution for 1887 105

McIntosh, Professor, 18. The eggs of fishes 58

Mason, Frank H., 50. Self-reproducing food for young fish 203

Mather, Fred, 7. Brown Trout in America 21

——, **61.** Report upon the results of Salmon planting in the Hudson River 409

Maynard, H. J., 15. Rainbow Trout in southwestern Missouri 55

Moore, Thomas J., 1. Report on a successful attempt to introduce living Soles to America 1

Mowat, Thomas, 9. Statistics of the Fisheries of the Province of British Columbia for 1886 24

——, **44.** Statistics of the Fisheries of the Province of British Columbia for the year 1887 .. 159

Muntadas, F., 52. Report on the Piscicultural Establishment of Piedra, Aragon, Spain .. 211

Nye, Jr., Willard, 45. Notes on the Fisheries of Buzzard's Bay and vicinity 160

Rathbun, Richard. See Collins, Bean, and Rathbun.

V

Page.

Ravenel, W. de C., 32. Report of operations at the Shad Hatching Station on Battery Island, near Havre de Grace, Md., during the season of 1887 95

——, **48.** Information bearing upon the artificial propagation of Mullet 197

Raveret-Wattel, C., 51. The Piscicultural Establishment at Gremaz (Ain), France.... 207

Redding, Joseph D., 17. Causes of the decrease of Salmon in the Sacramento River... 573

Regnerud, Carl, 38. Hatching Cod in Norway 113

Ruge, J. G., 8. The Sponge Fisheries of Florida 22

Seal, William P., 57. The Aquarium. A brief exposition of its principles and management 274

——, **58.** The keeping of Salmonidæ for purposes of exhibition 283

——, **59.** An inquiry as to the proper methods for the care of living things held for popular amusement and instruction, or for purposes of biological research 285

Smiley, Charles W., 11. Loch Leven Trout introduced in the United States 28

——, **12.** Notes upon fish and the fisheries 33

Smith, Everett, 4. Results of planting Shad in the Kennebec River 16

Smith, Hugh M. See Earll and Smith.

Smith, James A., 30. Report on the Shad work of the steamer *Fish Hawk* during the season of 1887 83

Southwell, Thomas, 3. Notes on the Seal and Whale Fishery of 1886 11

Stone, Livingston, 21. Best season for packing Salmon on the Pacific coast 65

Tanner, Z. L., 43. Report of the movements and operations of the Fish Commission steamer *Albatross* from September 15 to 20, 1887 155

Thorarinsson, Bened. S., 39. Notes on the Hatcheries and Fresh-water Fisheries of Iceland 120

Von Oterendorp, C. G., 33. A visit to the chief fishing places of Jutland 101

Wilcox, W. A., 22. The Fisheries of Gloucester, Mass., in January, 1887, with notes on those of other localities 66

——, **23.** The Fisheries of Gloucester, Mass., in February, 1887, with notes on those of other localities 68

——, **24.** The Fisheries of Gloucester, Mass., in March, 1887, with notes on those of other localities 70

——, **25.** Notes on the Frozen-Herring Trade with Newfonndland and the Bay of Fundy during the winter of 1886–'87 71

——, **26.** The Fisheries of Gloucester, Mass., in April, 1887, with notes on those of other localities 73

——, **27.** The Fisheries of Gloucester, Mass., in May, 1887, with notes on those of other localities 76

——, **28.** The Fisheries of Gloucester, Mass., in June, 1887, with notes on those of other localities 78

Worth, S. G., 47. The Striped Bass or Rock Fish industry of Roanoke Island, North Carolina, and vicinity 198

MISCELLANEOUS.

Statistique des Pêches Maritimes, 14. Sea Fisheries of France and Algeria in 1885 51

U. S. Senate and House of Representatives, 10. An act for securing statistics of the extent and value of the Vessel Fisheries of the United States 25

LIST OF ILLUSTRATIONS.

FISHES OF GREAT EGG HARBOR BAY, NEW JERSEY.—BEAN.

Page.

Plate I.

Fig. 1. *Astroscopus anoplus* 152
2a *Astroscopus anoplus*, head 152
4. *Chætodon maculocinctus* 152
9. *Bairdiella chrysura* 152
17. *Esox reticulatus* 152
20. *Erimyzon oblongus* 152

Plate II.

Fig. 6. *Cynoscion regale* 152
7. *Menticirrus saxatilis* 152
13. *Elacate canada* 152
14. *Sphyræna picuda* 152
15. *Tylosurus gladius* 152
18. *Lucania parva* 152

Plate III.

Fig. 3. *Tautoga onitis* 152
5. *Trachynotus rhomboides* 152
8. *Menticirrus saxatilis* 152
10. *Archosargus probatocephalus* 152
11. *Orthopristis chrysopterus* 152
12. *Centropristis furvus* 152
16. *Hemirhamphus roberti* 152
19. *Stolephorus eurystole* 152

KEEPING SALMONIDÆ FOR EXHIBITION.—SEAL.

Fig.—Method of aerating water in aquaria 284

CARE OF LIVING THINGS.—SEAL.

Plate I.—Pond aquaria 286
II.—Inclosed pond aquaria 286

BEAM-TRAWL FISHERY.—COLLINS.

Plate I.—Plans of steam fish-carrier *Australia* 292
II.—Steam-trawler *Zodiac* 294
III.—Plans of steam-trawler *Zodiac* 296
IV.—Plans of steam-trawler *Zodiac* 298
V.—Plans of steam-trawler *Granton* 300
VI.—Plans of ketch-rigged sailing-trawler 302
VII.—Sail plan of ketch-rigged sailing-trawler *Willie and Ada*, of Grimsby 304
VIII.—Deck plan of *Willie and Ada* 306
IX.—Trawling-cutters at Brixham 308
X.—Beam-trawl from above 310
XI.—Trawl-heads, beam, mouth of net, etc 312
XII.—Diagram of beam-trawl 318
XIII.—Boiler and engine used on sailing-trawlers 324
XIV.—Arrangement of boiler, engine, and gearing for operating capstan 326

Page.
PLATE XV.—Towing a beam-trawl 332
XVI.—Heaving up the trawl 342
XVII.—Pulling in the net 344
XVIII.—Dressing the fish 354
XIX.—Boxing the fish 356
XX.—Discharging a steam-carrier at Billingsgate 360
XXI.—Selling fish at Billingsgate market 362
XXII.—Grimsby fish market; receiving, selling, and packing fish 374
XXIII.—Trawlers in the fish-dock at Grimsby 388
FIG. 1.—Trawl-head 312
2.—Barking trawl-head 313
3.—Trawl-head for in-shore 313
4.—De Caux's trawl-head 314
5.—Shepherd's device 315
6.—Otter-trawl 316
7.—Shackle for otter-trawl 316
8.—De Caux's foot-rope 319
9.—Trawl-warp 321
10.—An early type of capstan 324
11.—An improved capstan 325
12.—The dandy-wink 327
13.—The dummy 328
14.—Trawl-warp roller 328
15.—Roller in use 328
16.—Dandy-bridle chock 325
17.—Fish-box 329
18.—Ice-mill 330
19.—A trawler's boat 331
20.—Hoisting the cod end 344
21.—The trawl's contents 345
22.—Boarding fish 357
23 —Ice-mill used by fish-packers 376
24.—Loading fish-vans 377
25.—Working up for a berth 381
26.—Visiting 387
27, 28.—French trawl-heads 389
29.—Foot-rope of Belgian trawl 391
30.—Belgian trawl-head 392
31.—Trawl-head, beam, etc., used in-shore 392
32.—Groen's trawl-head 395
33.—Dutch trawl-head 396
34.—Section of foot rope 397

REVIEW OF THE MACKERELS.—DRESSLAR AND FESLER.

PLATE I.—*Scomber scombrus*, Common Mackerel 431
II.—*Scomber colias*, Chub Mackerel, Tinker Mackerel. etc. 432
III.—*Auxis thazard*, Frigate Mackerel 434
IV.—*Gymnosarda pelamis*, Oceanic Bonito 436
V.—*Gymnosarda alletterata*, Little Tunny, Albacore, Bonito 436
VI.—*Albacora alalonga*, Germon, Long-finned Albacore 438
VII.—*Albacora thynnus*, Tunny, Horse Mackerel 439
VIII.—*Sarda sarda*, Bonito, Skip-jack 440
IX.—*Scomberomorus maculatus*. Spanish Mackerel 443
X.—*Scomberomorus regalis*, Pintado, Cero, Sierra 444
XI.—*Scomberomorus cavalla*, King-fish, Sierra 444

BULLETIN

OF THE

UNITED STATES FISH COMMISSION

FOR

1887.

1.—REPORT ON A SUCCESSFUL ATTEMPT TO INTRODUCE LIVING SOLES TO AMERICA.

By THOMAS J. MOORE,

Curator of the Liverpool Free Public Museum.

[Abstracted from the Proceedings of the Literary and Philosophical Society of Liverpool, No. XL, 1885–'86, p. 185.]

The geographical distribution of animals has important bearings on the welfare, comfort, and luxuries of mankind. The camel of Arabia, the reindeer of Lapland, and the fur-bearing animals of the far West are examples among mammalia. The naturalizing of the fowl, turkey, and pheasant are examples among birds of the extent to which man can influence their distribution for his own benefit, and the progress of the modern science of fish-culture promises well for the naturalization of important and delectable food-fishes in parts of the world where they did not previously exist.

The success which, after repeated failures, crowned the efforts of the persevering men who have introduced salmon and trout to Australia and New Zealand is a case in point, and the successful breeding of the American brook trout (*Salmo* or *Salvelinus fontinalis*) in Britain is another. Now the American lakes, rivers, and coasts, though abundantly supplied by nature with food-fishes both of nutritious and dainty kinds, are not provided with certain sea-fishes with which we are specially favored in the British Islands, and which are in the highest esteem for the table. The American States on the Atlantic side have neither soles nor turbots, and as a consequence the Americans are not happy.

In the Gulf of Mexico and East Florida they have a couple of flounders, and they have there also another flat-fish (*Hemirhombus pætulus* Bean), but of this last all the specimens but one were taken from the stomachs of red snappers (*Lutjanus blackfordii*). The limited supply of this flat-fish being so largely appropriated by appreciative snappers, there remain only the flounders, and what are they that they should serve as substitutes for soles or turbots?

The absence of the sole and the turbot has of late impressed itself on the American mind, and some ten years ago Prof. Spencer F. Baird, the head of the United States Commission of Fisheries, took the matter seriously to heart. The success which has attended the manual propagation of the salmon and other important food-fishes in Europe and America led him to consider the possibility of this method to supply the deficiency. With this object in view he wrote to me, asking if facilities would be given for the purpose by the owners of Liverpool fishing-smacks, if he sent a couple of agents from America to manipulate the spawn of soles and turbots as soon as taken from the trawl. The late Mr. Isaac, of St. John's Market, at once promised every facility for the purpose, as far as boats and trawls were concerned, but pointed out difficulties as to times and seasons which then, at least, were unfavorable.

Subsequently Professor Baird changed his views as to this method of proceeding, and determined to experiment on the transportation of the fish alive. To this end, after inquiries made, he put himself in communication with Mr. W. C. L. Jackson, then chairman of the Southport Aquarium Company, who, with Mr. Long, the manager, entered heartily into the proposal, for the mutual benefit of both parties by exchanges.

Accordingly soles and turbots of moderate size were obtained from the local fishermen and placed in the store-tanks of the Southport Company, where they remained in readiness for shipment. One of Professor Baird's practical fish-culturists, after delivering large numbers of impregnated ova of *Salmonidæ* in London and on the Continent, arrived at Southport, and after most careful preparations for transport shipped a moderate supply of fish. Great attention was paid during the transit as to temperature and aeration, but only two soles out of thirty shipped survived to be put out in Massachusetts Bay,* or less than 7 per cent. The losses were believed to be due to the fall of temperature when off the banks of Newfoundland. This was in January, 1878, and was very disheartening. A second attempt, in 1879, was a complete failure, as the fish were taken by rail from Southport to Southampton for shipment, and were bruised and fatally injured by the roughness of this overland journey.* Another attempt was made from Southport, in 1881, with poor results. Seventy soles were shipped on board the Parthia, and only three arrived out alive, or about 4 per cent.

In April, 1880, Capt. John H. Mortimer, a native-born American, first associate member of this society, had come in with his simple ship-aquarium, which I, at its first introduction some twenty odd years ago, named after him. In three or four of these Mortimer ship-aquaria he succeeded in safely landing five young soles out of nine that were shipped, or a proportion of over 50 per cent. These were provided by and sent from this Museum, and were deposited by Mr. Eugene G. Blackford just outside of Sandy Hook. This amount of success pointed to at least one promising method of solving the problem how to get soles alive across the Atlantic, and the trial in this case was the more severe inasmuch as it took place in a slow-sailing cargo ship, and not in a steamer. It had the great advantage, however, of Captain Mortimer's unremitting attention.

---

* Forest and Stream, November 3, 1881, p. 274.

During the present autumn (1885) Mr. W. A. Duncan, of the firm of Duncan & Sons, fish-merchants at St. John's Market, Liverpool, being about to spend a few weeks in the United States, informed me that he contemplated taking some live soles with him. They were to be carefully collected by his own trawlers, and he was anxious respecting the best method of transport, about which he was desirous of consulting me. On due consideration, he ordered a supply of fish globes and slung them up on Captain Mortimer's plan. Circumstances, however, prevented him from carrying out his intention, and he had reluctantly to give it up.

By permission of the Liverpool Library and Museum Committee, I had placed half a dozen small soles, from the Museum aquaria (where they had become "seasoned" and accustomed to confinement), together with one of Mr. Duncan's own specimens, in Mortimer aquaria, with a desire to take advantage of Mr. Duncan's kind offices in bringing something in return for them on his voyage home. Being desirous of adding to our American specimens by way of exchange, I applied to Mr. W. S. Graves, who, on behalf of the White Star line, kindly gave permission for half a dozen globes to be shipped immediately before sailing, on October 8, 1885, by the steamer Britannic, under the command of Capt. Hamilton Perry. The six globes, with two soles in each, were delivered on board by Mr. R. Paden, Museum assistant, and by Captain Perry's direction were suspended in the saloon, and open, of course, to constant observation. My only fear, on hearing of their being so honorably placed, was lest the temperature might be too high. Great, however, was my satisfaction, on going on board immediately on the return of the Britannic to Liverpool, to hear that of the supposed dozen specimens three had died, and eleven had been delivered alive and in good condition. This report, though so eminently satisfactory, was, to say the least, somewhat puzzling. The discrepancy in numbers was, however, due to a couple of fish having so effectually buried themselves in the bed of sand, with which each aquarium is supplied, as to be unobserved when the census was taken before leaving the Museum. This result is equal to more than 78 per cent. delivered alive.

A report in the American Angler, published in New York on the 24th of October, states that "these soles are to be sent to the Cold Spring

Harbor Hatchery on Long Island and afforded facilities for breeding which it is hoped they may sensibly avail themselves of. The sole is, without question, the most delicious of the flat-fishes for the table, and its addition to the food-fishes of our waters would be a very valuable acquisition."

Mr. Blackford wrote as follows, under date of October 31, 1885:

"I received by the steamer Britannic the lot of soles which you have so kindly sent to this country, and I must congratulate you upon the success which attended their safe transportation. * * * I shall take great pleasure in sending you, at the first opportunity, some of the living amphibians, &c., which you desire."

The aquaria, or fish globes, used in the transport of these fish are of thick glass and weighty. They are 14 inches in diameter at the middle, 7 inches across the mouth, and hold about 4 gallons of water. They simply rest each on a circular wooden disk, an inch thick and 16 inches in diameter, suspended by light cords to a stout ring, by which they may be hung on a hook, like a swinging lamp. A layer, an inch or two in depth, of fine sea-sand from the Cheshire shore covered the bottom of each globe, which was rather more than half filled with sea-water. The whole affair is simplicity itself, and would be almost absurd for the accomplishment of any serious purpose if it was not for its proved success.

That it is not to be despised, however, is evidenced by the following summary of what has been accomplished with it in the service of the aquarium of the Liverpool Museum, as given on the placard attached to the pair of globes now exhibited, each globe containing a couple of soles* as in the experiments above recorded:

"By the simple contrivance of suspending ordinary fish globes (the most convenient vessels for the purpose) after the manner of cabin lamps, small aquaria of considerable utility can be kept at sea as easily and safely as on shore. They thus supply a very convenient means for the observation and study of the various living objects of small size obtainable by the dredge or by the towing net, and also afford a pleasant and useful resource to break the dull monotony of life at sea.

"Originally designed by Captain Mortimer to facilitate his own studies, and for the conveyance of living American fish to the Liverpool Free Public Museum, they have been the means, by himself and others, of importing to the aquaria of that institution a considerable number and variety of living fish and other objects, not only from New York, Boston, and other parts of North America, but also from Brazil, from Chili, from the Mediterranean, from the West Coast of Africa, and from the

---

* These soles so effectually buried themselves in the sand at the bottom of the globes that it was necessary to stir them up with the hand to prove they were really there; indeed, I had to do the same thing before bringing the globes to the meeting, to satisfy myself. This is conclusive proof of the kindly way in which they take to the sandy bottom provided for them.

Indian Ocean; and although the capacity of such simple vessels is necessarily small, it has sufficed for the successful importation of several young sturgeons from Hamburg to Liverpool."

The special advantages of the Mortimer ship-aquarium, for purposes like the present, are as follows:

(1) Its extreme simplicity, and the small amount of trouble involved.

(2) Its handiness in conveyance to and from the ship, as well as on board.

(3) Its transparency, giving every facility for observation, whether for study or mere inspection as to purity of water and health of fish.

(4) Its easy swinging motion when suspended, the surface of the water being but little disturbed during considerable departure from the vertical center.

(5) Its facilities for feeding the fish if required, and for the removal of refuse, as also for drawing off the water when requisite, and supplying clean water in its place.

(6) Its facilities for simple aeration.

(7) Its saving, more than any other form of vessel, of the fish from injuring themselves by striking against the prison walls, by the motion of the ship or otherwise, a matter of the greatest importance.

(8) Its comparative strength, similar aquaria having been carried four times across the Atlantic in all weathers, and in the long voyages of a sailing ship, without coming to grief.

(9) It facilitates also the use of sand as a bed or bottom.*

The soles, by the waving motion of their body and fins, cause the sand to rise, and, in falling, to cover them so effectually that they are scarcely discernible, as evidenced above. Sometimes only their eyes, or an outline of the head or body, can be seen; at others a circular track only is visible, caused by the continued moving of the fish, which perforce results in a circular outline of its track. The comfortable look of the soles, often to be seen in our large aquaria, was so striking in those put into the globes for Mr. Duncan that it made me more than ever bent upon so accommodating them. They had all the appearance of being literally tucked up in their bed, and lightly breathing.

These advantages are difficult or impossible of attainment, singly or in combination, in vessels of wood or iron. Much ingenuity has been exercised as to the construction and aeration of tanks of various kinds and sizes and the regulation of temperature for transporting soles on a far larger scale, but the results hitherto have not been commensurate with the labor expended, and the importation of soles to America in greater numbers than above recorded has yet to be accomplished.

There is, however, an all-important matter requiring attention besides the form of vessel in which the soles are to travel, and that is, as in so many other matters, you must first catch your fish, which itself is comparatively easy; but this is not enough, you must catch him without injuring him, which is by no means so easy, at any rate with a trawl, and impossible in a trawl working in the ordinary way for fish for market. Trawls so working are down for several, perhaps five or six, hours. And how can fish, especially small ones, escape without bruises of every degree of violence? And how can bruised fish be expected to live? Now the soles in the Museum aquaria are of small size, from 4 or 5 inches in length upwards. These are caught and brought in by poor boatmen, fishing with small nets only, in or at the mouth of the Mersey, and consequently the fish are less injured. The specimens sent to America were thus caught, and had time to die or to get well and used to confinement, "seasoned," in fact, or "educated," as Mr. Duncan called it, before being "transported." These circumstances have doubtless had a share in the success of the venture, the main cause of which was due to changing the water carefully every day. The three deaths mentioned occurred before the water was so changed, and none occurred after in that consignment.

---

* I attach great value to this use of sand, and always use it or an equivalent in all aquaria. The late Mr. W. Alfred Lloyd objected to it as likely to choke any fish, but I have never found it to do so; on the contrary, the gills keep themselves clear from its intrusion by their own action.

Mr. Blackford has already sent in return living specimens of the *Limulus*, or king-crab, and promises fish and amphibia to follow. King-crabs are not new to us, but we have long been without them. Our first living specimens were brought by Captain (now Sir James) Anderson, while in the Cunard service, prior to laying the Atlantic cable from the Great Eastern steamship. That supply, I think the first imported to England, besides supplying our own wants to the full extent of our accommodation, enabled us to send living examples to London, Oxford, Dublin, and elsewhere.

Dr. David Walker, late naturalist to the Fox Expedition in search of Sir John Franklin's remains, going on a visit to Paris, kindly took one wherewith to initiate friendly relations with naturalists there. But the professor he took it to was at dinner and would not be seen, and was so long at dinner that Dr. Walker took umbrage and brought his king-crab back again across the Channel, till, just before landing, his patience and endurance being quite exhausted, he threw the exceedingly awkward prickly creature overboard. Some short time thereafter Dr. J. E. Gray, of the British Museum, received a specimen which had been washed ashore on the south coast, and, therefore, positively asserted it to be an important addition to the marine fauna of England.

Very recently several further consignments of soles have been successfully made by the same means and by the same channel as before noted. It has been found that four specimens may be safely transmitted in each globe, and on one occasion I was informed by Mr. Bartholomew, the chief steward of the Britannic, that every one of the twenty-four shipped in the six globes arrived alive at New York, showing that complete success is possible of attainment, though of course some losses will generally occur. Mr. Blackford, previously to this, had written as follows:

"JANUARY 13, 1886.

"I am in receipt of your esteemed favor of the 31st ultimo, and am also in receipt, per steamer Britannic, of the live soles. I cannot express my joy and gratitude in view of the interest your institution has taken in this exchange. I see in it the promise of the successful carrying out of what I have long desired, that is, the importation of a sufficient number of these fish to enable us to determine whether they can be acclimated and reared in our waters."

Of one of the late consignments, Prof. Spencer F. Baird, head of the U. S. Fish Commission, wrote thus to me:

"WOOD'S HOLL, MASS., *July* 16, 1886.

"I am happy to report the success of the latest shipment of soles made to Mr. Blackford, per Britannic, for the service of the U. S. Fish Commission. Twenty of the twenty-five shipped are alive and in good condition, and feeding voraciously in our tanks."

Of a still later consignment of twenty-four fish, of which six died, possibly from the excessive closeness and warmth of the weather before the Britannic reached Queenstown, Mr. Blackford wrote as follows:

"NEW YORK, *August* 26, 1886.

"I received through the hands of Mr. Bartholomew seventeen live English soles, which I at once forwarded to the U. S. Fish Commission's headquarters at Wood's Holl, sending a special messenger along with them, and he has just returned, reporting their safe arrival at that point, where they were placed with the previous lots. We are keeping these fish in large salt-water ponds to see if it is possible to breed them there."

LIVERPOOL, ENGLAND, *September* 16, 1886.

2.—THE CANADIAN AND AMERICAN FISHERIES OF THE GREAT LAKES.

By JOHN H. BISSELL.

One of the ways in which the Canadian treatment of the general subject of fisheries is valuable is the exact and useful knowledge which they obtain of the whole subject. This accurate knowledge of the fisheries is serviceable in many ways. For instance, it enables the legislature to know its importance as a subject of legislation; it tallies from year to year the success or failure of the preservative measures; it points out distinctly the value of artificial propagation and the points at which natural sources of resupply need re-enforcement by artificial and scientific methods. The Canadian reports show the total value of the fishery product of the Dominion, and also minutely the relative value of each item or variety of fish, as well as that for each province.

There is before me the Report on the Fisheries of Canada for the year 1883. On the first page is the statement that the product of 1883 was $134,100.64 more than for 1882 for the Dominion; the total valuation for 1883 being $16,958,192. Of course the greater part of this enormous production is of salt-water fisheries, while the principal interest of dwellers along the Great Lakes is respecting the Canadian fresh-water fisheries—those of the province of Ontario. Before going into that, however, it will be interesting to look at the reports of 1884 and 1885, and compare the total production for those years with the total of 1882 and 1883. The figures are given as follows:

1882	$16,824,092 34
1883	16,958,192 98
1884	17,852,721 00
1885	17,722,973 18

There was a general increase for 1885 in all provinces except that of Nova Scotia, where there was a decrease of "nearly half a million in the item of mackerel alone."

Turning now to the province of Ontario we find the total value given for 1883 to be $1,027,032.88, an increase over 1882 of $201,575.86. The principal items in the order of their values are:

Salmon trout	$354,692 72
Whitefish	264,581 60
Herring and ciscos	97,070 00
Pickerel	82,096 38

The expenditure for "fishery service" for the entire Dominion for the year 1883 was no less than $114,673.76, and in 1884 was $116,531.66, of which the amounts for the province of Ontario were as follows:

Purpose.	1883.	1884.
Fishery officers, salaries and expenses	$13,602 00	$15,192 73
Fish-breeding	10,144 95	8,011 17
Total	23,746 95	23,203 90

The total expenditure for fish-breeding in the Dominion for 1883 was $25,776.87, and the amount for fishery officers was $62,341.43. The total value of the fish product of Ontario for 1884 was $1,133,724.26.

The number of men employed in this province as fishery officers in 1884 was 82, for a coast line no longer than that of the State of Michigan. This number of men, designated as "fishery officers," does not include the men employed in fish-breeding, but only those employed as inspectors, overseers, and wardens to enforce the fishery laws.

We desire to call particular attention to the figures for the year 1885, because that is the only year in which the Michigan fishery product has been accurately reported, and consequently the only season's fishing for which any reasonable comparison can be made between this State and the province of Ontario.

The total fish product of the province of Ontario for 1885 in value was $1,342,691.77, or a little over 4⅔ cents per pound on the average.

	Pounds.
Whitefish	3,938,500
Trout	5,431,654
Herring	11,941,200
Muskallonge	565,400
Bass	636,397
Pickerel	1,757,494
Sturgeon	1,459,035
Pike	468,430
Other kinds, coarse fish and eels	2,578,908
Total	28,777,018

This statement includes 913,100 pounds of fish consumed at home by the fishermen and their families or by others, so as not to appear in the totals of the amount marketed.

During 1885 the expenditure for "fishery service" for the Dominion was $153,215.56; for fishery officers, $77,821.67; and for fish-breeding, $43,879.82.

For the province of Ontario, in 1885, there was expended—

For fishery officers, salaries and expenses	$17,135 98
For fish-breeding	8,690 15
Total	25,826 13

It should be noticed that the figure $8,690.15 for fish-breeding does not include the salary of the superintendent or office expenses. Further, it is for the maintenance of two fish-breeding establishments; one at Newcastle, for trout and salmon, and one at Sandwich for whitefish and pickerel. The State of Michigan maintains four establishments or hatcheries, the estimated cost of which was $9,476. On the basis of these figures the output of young fish is about 20,000,000 in excess of the Canadian hatchery product, while the excess of expenditure is only about $800. It should also be noticed that the expenditure in Michigan for all purposes connected with the fisheries was, for 1885, but $12,000 (not including permanent improvements), against the Canadian expense for the same year, for fish-breeding and care of the fisheries, $25,826.13, as given above.

The force of this comparison will be more fully appreciated from the figures given below, which show the product of Michigan fisheries to be about equal to those of Ontario in weight; and if the values are computed at the same rate as the Canadian, the total value will be about the same.

In the seventh Michigan report (1886) the catch of 1885, as there estimated, is 26,381,875 pounds. Adding to the amount allowed by the Canadian report for home consumption, not reported, 913,100 pounds, we have, as the total to be estimated, 27,294,975 pounds.

This, at the rate allowed in the Michigan report (3 cents per pound), is equal to $818,849.25. But if taken, as the Canadian product is, not by a general average, but at their figures for each species, the result will be as follows:

Michigan product, 1885.

Kind.	Pounds.	Price.	Value.
		Cents.	
Whitefish	9,985,015	7⅕	$718,821 08
Trout	5,469,812	7½	410,235 90
Herring	5,249,384	2⅖	126,510 15
Pickerel, bass, and sturgeon	1,530,161	5	76,508 05
Other kinds	5,060,603	3	151,818 09
Total	27,294,975	5 1/10	1,483,893 27

Product of Michigan and Ontario, 1885.

	Pounds.	Value.
Michigan	27,294,975	$1,483,893 27
Ontario	28,777,018	1,342,691 77
Difference	1,482,043	141,201 50

The excess of the Ontario product over that of Michigan is thus seen to be 1,482,043 pounds, while the value of the Michigan product is $141,201.50 above that of Ontario. This result is accounted for by the larger production of whitefish in Michigan waters, as shown by the following comparison:

	Pounds.	Value.
Michigan	9,985,015	$718,821 08
Ontario	3,938,500	282,950 00
	6,046,515	435,871 08

Or if the Michigan product is figured at what is probably the exact Ontario average price, as their fish run, that is, 4⅔ cents per pound, it is $1,271,945.83. But, in view of the larger production of whitefish in the Michigan catch, it does not appear that the above comparison is at all unfair.

Taking the products of the two States as about equal in quantity and value, there is a very noticeable difference in the amounts expended by each in the care and conservation of this industry, as shown above. The coast line of each State is of the same length, about 2,000 miles.

DETROIT, MICH., *March*, 1887.

3.—NOTES ON THE SEAL AND WHALE FISHERY OF 1886.

By THOMAS SOUTHWELL, F. Z. S.

[From the Zoologist, London, England, May, 1887.]

We must go back many years in the history of the seal and whale fishery before we shall find so disastrous a season in all respects as the past has been; certainly it is unparalleled in the history of the Dundee fishery. A season of great severity has resulted in poor catches, still poorer prices for produce, and in the loss of one ship at Newfoundland and four in Davis Strait. It is not likely, with the present prospects, that any of these will be replaced, and it is even doubtful whether all the vessels which returned from last season's fishing will repeat the venture in 1887. In addition to this there are rumors of a partial desertion of the northern fishing grounds for the purpose of exploring the polar seas of the Southern Hemisphere.

The first disaster occurred on March 27, when the Dundee steamer Resolute was crushed in the ice in Notre Dame Bay, off Newfoundland, the crew having barely time to save themselves by jumping on the ice, where they suffered intensely from cold and exposure, having to travel 70 miles over ice before they reached a place of safety, while three of their number, at first believed to have been lost, were subsequently picked up by the sealer Hector, and landed safely at Saint John's. The Resolute at the time of her loss had 20,000 seals on board. Another Dundee vessel, the Aurora, had a narrow escape. Four days after leaving Saint John's she discovered the main pack of seals, and had every prospect of securing a full cargo, but a gale of great violence coming on, which continued for several days, she was driven before its force a distance of about 100 miles, ultimately to be stopped by an iceberg off Cape Bonavista, where she remained in a position of great danger from the falling ice. Soon after, a second iceberg floating down upon her crushed one of her boats, and injured the ship so much that she began to leak; all this time the weather was of great severity, and the snow and mist were blinding. Ultimately the ice eased, to the intense relief of her crew, and with the loss of one of her men the Aurora returned to Saint John's to refit. On her second trip she secured 640 old seals.

The total result, so far as the 21 British vessels which took part in the Newfoundland fishery were concerned, was one lost, two clean, and among the remaining 18 vessels a take of 195,396 seals, against 211,587 for 19 British vessels last year. Of these the Ranger took 35,894, the Falcon 24,768, the Wolf 19,521, the Leopard 15,954, and the Greenland 15,000. Of the remaining 13 vessels the total catch was 84,259, or an average of 6,481; the average of the whole 18 being 10,855 seals, the produce of which was worth about £18 10s. ($90) per ton.

Taking the Dundee portion of the above fleet alone, which consisted of 6 vessels, one, the Resolute, before mentioned, was lost, and the remaining 5 vessels brought home only 41,606 seals (as against 71,272 for the previous season), or an average of 8,321 each. It will thus be seen that for the whole of the Dundee vessels and 10 of the Saint John's fleet the voyage, so far, must have been a most unprofitable one, even if the price of produce had been much higher than it now is. Practically, only the 5 vessels enumerated as having taken 15,000 seals and upwards made paying voyages.

The Greenland sealing has this season been an entire failure, not so much, perhaps, from the absence of seals as from the severity of the weather and the state of the ice preventing an approach to the breeding pack. The passage out was a fair one, and the seals were found on April 2 in latitude 74° north, longitude 2° east, but the weather proved so tempestuous that they could not be reached until the 7th, and the strong gales had then broken up the ice into small patches, and thus dispersed the seals. Three Scotch vessels only were present, the Erik, Hope, and Earl of Mar and Kellie (the Eclipse did not take part in the young sealing), and they captured about 4,500 "white-coats;" there were also 21 Norwegians, who secured some 31,500 others, in addition to which there were also about 4,000 old seals killed, making a total of, say, 40,000 old and young seals. In consequence of the lateness of the season the young seals were in very fine condition, and probably 16 days old, as the parents generally take to the ice about March 22. The old sealing later in the season was equally bad. The total number of old and young seals brought in from the Greenland and Davis Strait fishery was 7,964, against 32,302 in the season of 1885.

I regret that in my last year's notes, by an error, I stated that there were 18 Scotch vessels present at the Greenland sealing; this was the total number both at Greenland and Newfoundland. I should have stated that 10 Scotch vessels took part in the Greenland and Davis Strait sealing, capturing 26,448 seals, and that the proceeds of 5,852 other seals were brought home by the Germania from a station in the Cumberland Gulf.

At Newfoundland and Greenland together, the 13 Scotch sealers last season killed 49,570 seals (against 103,574 in the season of 1885). These, at 6*s.* per skin, would represent a sum of £14,871 ($72,273); and the yield of 582 tons of oil, at £20 per ton, a further sum of £11,640 ($56,570); gross total, £26,511 ($128,843), against an estimate in 1885 of £57,412 ($279,022)—a sad falling off, which in this branch of the fishery must represent a considerable loss to those engaged in it.

In the article "Seal Fishery," in the 21st volume of the Encyclopædia Britannica, p. 582, are some remarks with regard to what is there termed the "Jan-Mayen Seal Fishery," which are likely to be very misleading. It is stated that the British, Norwegians, Swedes, Danes, and Germans all take part in the fishery, and that the number of seals taken by the

British vessels "about equals that taken by all the others together." If by the "Jan-Mayen Fishery" the author means the capture of young saddle seals at the Greenland west ice, this is certainly not correct; the foreign vessels at present greatly outnumber the British, and the number of seals taken by them is proportionately larger. It will be seen that in the season of 1886 the number of British and foreign vessels present were respectively three of the former and twenty-one of the latter, and for many years past the disparity has been almost equally great. The Norwegians, who did not commence sealing till 1845, now outnumber all the other nationalities. Previous to that time there were more Germans, Danes, and Dutch than there are Norwegians at present. The author is also incorrect in stating that the Scotch steamers are chiefly manned by Shetlanders. It is usual for the whalers to complete their crews at Lerwick, and last season the Eclipse added to her crew of 40 men 15 Shetlanders, bringing the number up to 55, and this, I believe, is about the usual proportion. Again, although it is stated that a close time has been established in the Jan-Mayen fishery, the writer goes on to say that "the vessels make the ice from the 15th to the 20th of March, and commence the chase in the destructive way already described." The way "already described" happily refers to what has, since 1877, become a thing of the past. In that year the close time came into operation, and now, within an area included between the parallels of 67° and 75° north latitude, and between the meridians of 5° east and 17° west longitude from the meridian of Greenwich, not a seal is killed till April 3. That date is still believed by some to be too early, but this restriction has completely revolutionized the mode of sealing; the mother seals are no longer killed without mercy when they come to suckle their young, and the latter left "to die in thousands of starvation." As a matter of fact it is the young "white-coats" which are now so much valued. The German vessels made a business of sealing many years before the English took any decided part in it, the latter only picking up a few seals occasionally, but about the commencement of the present century seals begin to figure largely in the returns of the British ships. It was not, however, till the year 1840 that the port of Dundee first sent out ships to the Greenland sealing; but this date by no means coincides with the commencement of the Jan-Mayen seal fishery, as stated by the writer in the Encyclopædia Britannica.

The Davis Strait whaling voyage was a very disastrous one. On April 5, during a most terrific gale, the Triune was forced upon a reef in latitude 66° north, where she remained frozen up till the 18th, when she was released, but in steaming through the ice-floe she received a very severe nip, which ultimately resulted in the crew being compelled to abandon her off Scott's Island in latitude 71° north, on August 16. At the same time and place as the Triune, the Jan Mayen was also caught in the squeeze, and sunk shortly afterwards. The Star was likewise lost in Cumberland Gulf, making, with the Resolute before-mentioned, four Dundee vessels which fell victims to the "thick-ribbed ice" last season. Nor was this all, for the Catherine, of Peterhead, a sailing brig of 190 tons, after various adventures on reefs and rocks, was finally beached and abandoned on September 30 in Cumberland Gulf. Fortunately, the crews in all cases were rescued.

In Davis Strait plenty of whales are reported to have been seen both in the early and late fishing; but the weather was so bad, combined with heavy seas and ice-floes of a very dangerous character, that fishing was impossible; and during the summer months, when the best fishing is usually met with, the young whales which, as a rule, are then found in Lancaster Sound, although the ships were through Melville Bay in good time to meet them in passing, were altogether absent, having, it is conjectured, taken some other passage.

The Davis Strait and Cumberland Gulf vessels, ten in number, killed 19 whales. These are said to have yielded 380 tons of oil and 290 cwt. of bone, giving an average of 20 tons of oil and 15 cwt. of bone each, a very high average for the Strait whales, which is probably to some extent accounted for by the summer fishing of the young whales being a failure, those taken being in consequence all adults. Of this I shall have something more to say presently.*

The seal fishery offering no temptation for an early start, and consequent greater outlay on the voyage, Captain Gray, of the Eclipse, deferred his departure from Peterhead until April 20, with the intention of devoting his energies to whaling and shooting old seals; of the latter he obtained 700 and of the former 7. In the Greenland seas the Eclipse and Erik, from Peterhead, and the Pole Star, from Dundee, captured 15 whales, yielding 88 tons of oil, and 80 cwt. of bone—the whales averaging just over 5¾ tons of oil and 5⅓ cwt. of bone. The Hope and Aurora, as also the Earl of Mar and Kellie, which paid a short visit to the Greenland whaling, were unsuccessful. Fourteen of the above whales were taken early in the season, and in about the same locality, the remarkable feature about them being their small size.

The relative size of the whales taken in Davis Strait and Cumberland Gulf, compared with those usually taken in Greenland, has in the past season been quite reversed. A large number of Davis Strait and Cumberland Gulf whales, taken over a period of years, produced an average of 9½ cwt. of bone each; whereas the Greenland whales, captured during the same period, yielded 11 cwt. each; but in the past season the averages have been 15 and 5½ cwt. respectively.*

---

* The disparity between the quantities of bone and oil as stated above is certainly too great; there is always a remarkably constant proportion of one hundredweight of bone to each ton of oil, and this holds good with whales of all sizes. The Traveller brought home from Cumberland Gulf some whale oil which had been left out last season; but in addition to this I think there must be some inaccuracy in the reported quantity of oil; possibly some of the white-whale oil has been accidentally entered as whale oil.

This may at first sight appear very remarkable, but it is quite intelligible to those acquainted with the habits and seasonal distribution of these creatures. We have seen that the Strait fishermen, owing to circumstances of weather and ice, missed the young whales, which would have reduced their average; whereas the Greenland fishermen, likewise, from force of circumstances, could only get among young whales early in the season, and later on, owing in a great measure to the ice being so closely packed and its edge so far west, they missed the south fishing altogether. But this is not all. From long experience of the habits and migration of the whales, the regularity of which is remarkable, the whalers know precisely where they should be found, under favorable circumstances, at certain definite periods, and not only so, but also the age and size which may be expected. I am not at liberty to enter more fully into this subject, fearing to commit a breach of confidence, as it is the application of accumulated experience on such points which enables one man to succeed in capturing whales, when a less accurate observer would fail; but I may add—to show that the migratory habits of the whales have not changed—that the celebrated capture of 44 whales by Captain Suttar, of the Resolution, in 1814, was effected in the same latitude as produced the Greenland whales of the past season. Captain Suttar's average was 5 tons 13 cwt., and 14 of the Greenland whales last season, taken by two vessels fishing together in the same latitude as Suttar's, gave precisely the same average.

It is difficult to say what is the value of commodities which are hardly marketable; but at £20 per ton, the 477 tons of oil brought home by the Dundee and Peterhead vessels would be worth £9,540 ($46,364), and the 18½ tons of bone at, say, £1,100 per ton all round,† another £20,350 ($98,901), or a total of £29,890 ($145,265), against £31,800 ($154,548) in the season of 1885.

There has been a further considerable falling off in the British bottlenose fishery, only 23 whales, yielding 22 tons of oil, having been brought in, against 84 killed in 1885; but I am informed that the Norwegians have in the past season killed the enormous number of 1,600 or 1,700 of these creatures, which has so flooded the markets of London and Glasgow with their oil that it has been sold as low as £17 or £18 per ton—a circumstance which will account for the neglect of this branch of the fishery by the Scotch vessels, the owners of which not many years ago realized £50 or £60 per ton for the same oil.

---

*As before stated, the yield of bone is more reliable than that of the oil for purposes of comparison; I therefore prefer to give that of the bone only, but each cwt. of the latter may be taken as representing an equivalent of one ton of the former.

†Some "size bone" (*i. e.*, bone the slips of which are 6 feet and upwards in length) has recently been sold at £1,550 per ton; but as the "undersize" bone produces only half the price of the "size," the price for the average is largely reduced. This must have been particularly the case in the past season, many of the whales being very small, and the proportion of undersize bone being consequently unusually large.

Some of the vessels brought home very miscellaneous cargoes—1,033 white whales, 320 walruses, and many narwhals and bears—the scarcity of big game, I presume, rendering the pursuit of such small deer the more keen.

During his voyage to the Greenland fishery, when in latitude 70° N., longitude 16° W., or about half way between Jan-Mayen and Greenland, Captain Fairweather, of the Aurora, reports a singular phenomenon. On August 16, about midday, his vessel received a sudden shock, caused by what he considers must have been an earthquake (or seaquake). "The sensations," he says, "felt by those on board were as if the ship was moving over a rocky bottom with great velocity." The officers and crew immediately rushed on deck, thinking a boiler had burst, or that the ship had gone aground, but the boilers were all right, and the lead failed to find bottom at 100 fathoms. The weather was foggy, with slight rain and wind from ESE.; no upheaval of the water was noticed, the sea being unusually calm. About two hours later, a second but much lighter shock was experienced, which, however, only caused the vessel to tremble.

NORWICH, ENGLAND, *May*, 1887.

4.—RESULTS OF PLANTING SHAD IN THE KENNEBEC RIVER.

By EVERETT SMITH.

[*From a letter to Prof. S. F. Baird.*]

In 1880 I accompanied and personally directed the disposition of the shad fry planted in the Kennebec River at Waterville, the first plant, I believe. My interest officially as State Commissioner of Fisheries at that time did not exceed my interest as a naturalist in the experiment, which interest has been continuous. This month there have been caught at Cape Small Point, at the mouth of the Kennebec River, a considerable number of shad of such large size, and of such general proportions and appearance as to show a marked contrast with the native Kennebec shad. As distinctive as the 3 to 5 pound shad of the Kennebec from the 2 to 4 pound shad of the Nonesuch River, of Cumberland County, Maine, are these large shad of 5 to 7 pounds weight lately caught, which I believe to be Chesapeake Bay shad, hatched in 1880. I have examined a number of 6 and 6½ pounds in weight and one of 7 pounds. They were caught together, evidently from one school, with none of the usual sized Kennebec shad of less weight and appearance.

PORTLAND, ME., *May* 26, 1887.

Vol. VII, No. 2. Washington, D. C. May 26, 1887.

5.—AMERICAN FISH CULTIVATED BY THE NATIONAL FISH CULTURE ASSOCIATION OF ENGLAND.

By W. OLDHAM CHAMBERS.

[Abstracted from the Journal of the National Fish Culture Association, London, England, April, 1887, p. 137.]

The collection of fish eggs for the season of 1886-'87 began in October, 1886, at the establishment of the association at Delaford Park. The fish first operated upon were the *Salmo fontinalis*, hatched at South Kensington in 1885 from ova presented by Prof. Spencer F. Baird. Considering their age and weight, the latter being about half a pound, the circumstances attending their reproductive capacity are worthy of note. The date at which they spawned was unusually early, notwithstanding their being confined in ponds for about 18 months. The eggs produced were small, and of a lighter yellow color than those from which the parents were hatched. The time of incubation occupied about 65 days, during which period the death-rate showed a percentage of 15. The fry, on emerging from the eggs, were very dark in appearance, and have been remarkably strong and active throughout. A few at first were attacked with "blue swelling," but on being placed two or three times in earth mixed with water to the consistency of cream and carefully strained, they became temporarily relieved, but ultimately succumbed to congested liver. The fry have been placed in the nursery ponds, where they are feeding well and seem to be thriving.

On January 31, 1887, a consignment of eggs from America was received, consisting of 1,500,000 ova of the whitefish (*Coregonus albus*) and brook-trout ova (*Salmo fontinalis*). Nearly all the whitefish eggs were found dead on arrival, owing to undue pressure from the trays being too large (namely, 18 inches square). The brook-trout eggs, which were forwarded in smaller trays, arrived in good condition. On the failure of the first consignment being reported, the U. S. Fish Commission sent a further shipment of 1,000,000 whitefish eggs; but the second lot was received in almost as bad condition as the first, owing to the same cause, the temperature of the box being too high, and many thousands of the eggs hatching out while on the way.

With the eggs of the whitefish arrived also 9,000 rainbow-trout eggs (*Salmo irideus*) from America, 1,000 of which had died during transit. These eggs are now hatching,* and the fry appear to be strong and vigorous. The color of the eggs is of a yellowish tint, tinged with a purple brown, before hatching, thus producing an unhealthy appearance.

---

*A note elsewhere in this journal states that on April 8, 1887, all the rainbow trout in the association's ponds at Delaford were maliciously poisoned, and it will be impossible to replace this loss for some time.

The association is also indebted to the U. S. Fish Commission for 25,000 eggs of the landlocked salmon (*Salmo sebago*), which reached the hatchery on March 20 in excellent condition. They were carefully packed on trays surrounded in muslin, with moss between each layer of eggs. Instead of sawdust, wet moss was closely packed around the nest of trays, to which fact I partly attribute the success of the shipment. The instance cited is probably unparalleled in the records of transmitting ova, there being only three dead eggs on arrival, and only 30 were found dead on the next morning.

The sight presented in the hatchery tanks is very interesting. The different colors of the gill-sacs of the various fish, especially of the different kinds of trout, is well seen in the struggling masses of tiny forms, which appear to be in a healthy condition. Their aptitude for congregating in corners of the hatching-trays shows not only their instinct to avoid danger, but also their physical condition. Fish that are sickly are usually found apart from the others, as not having the power to cope with them. It may be interesting to compare the habits of the whitefish on coming from the eggs with those of the trout and salmon, as the whitefish act very differently from these other fry. The whitefish is of a light gray color and about one-quarter inch long when hatched. Upon emerging from the egg it lies dormant for about two hours, after which time it is generally in a state of activity. Its infantile powers of locomotion are great, and its capacity for exercising them is unusual. Darting hither and thither continually, with their large bead-like eyes prominently displayed, they are an interesting sight. Trout and salmon, on the other hand, preserve a quieter attitude on entering upon their career, and are not in perpetual motion.

Much effort is being made to acclimatize and propagate the American whitefish in England, though considerable difficulty exists in securing suitable places for it. Evidences of its capacity for thriving in this country are not wanting. The Marquis of Exeter last year turned into a portion of his water at Burghley Park some fry of this species as an experiment, and now they are 7 inches long. A few weeks ago one was taken at Delaford 6 inches in length. The fish are now yearlings, and have consequently passed through the experiences and vicissitudes of all seasons, and may therefore be considered to have become accustomed to their present existence.

The most difficult problem in whitefish culture is how to feed them upon losing their sacs. After experimenting with multifarious diet, aries, I finally settled upon one which has hitherto proved efficacious. This consists of a finely-powdered meal, made by Mr. William Burgess, of Malvern Wells. This meal is mixed with the blood of animals and with water, in the following proportions: 2½ parts meal, ½ part blood, and 6 parts water. This food is so fine that it can be absorbed or imbibed by the fish without any effort or unnatural exercise of their digestive functions. Moreover, the food is readily consumed by them, and it is not ejected, as is the case with liver and roe.

The results previously attained in the endeavor to acclimate certain varieties of American *Salmonidæ* encourage the association to continue its efforts in this direction. The original list of transatlantic forms for introduction, which after all bear a striking resemblance to their cousins on this side of the Atlantic, has undergone considerable modification, and is limited to the really valuable food-producing forms whose presence in Engish waters cannot prove prejudicial to indigenous fish, but, on the contrary, may become an important acquisition in developing inland and populating barren waters. The following species would, it is believed, prove of undoubted value: Rainbow trout, *Salmo irideus;* landlocked salmon, *Salmo sebago;* and whitefish, *Coregonus albus.*

It is with reluctance that we omit from this list the American brook trout, *Salmo fontinalis*, which has had an excellent chance of asserting its qualifications for introduction into our group of *Salmonidæ*, but has failed to do so, except in confined waters. Its first appearance in this country was heralded with jubilant anticipations; its capacities for rapid growth were hailed as a good omen, and its gorgeous dress and graceful form won golden opinions from all piscatorial classes, who willingly paid large sums of money for what was then considered the coming trout. Gradually, however, its true character appeared, and now it is universally regarded as a fish not to be depended upon. No authority rebuts the evidence forthcoming as to its suitability to British waters, if inclosed, nor as to its value as an addition to our fresh-water fish. The sole cause, and a very grave cause it is, for its denunciation is that it escapes from those places where it is turned in. Before finally discarding this unique char it behooves us to question more closely than we have yet done its habits, instincts, and the nature of its native home, in order to render it full justice. Probably the waters in which it has been placed have not been suitable, and this assumption certainly seems justified by the fact of the fish wandering as it does. The question naturally arises as to where it goes. Does it find suitable places in its wanderings? Does it descend to the sea, or does it pine and perish for lack of natural conditions? If death explains the mystery, which is hardly likely, we have at once a solution; but if not, it is difficult to say what has become of the thousands turned out into our English streams. In America the brook trout is regarded as a home-loving fish, therefore it seems somewhat likely that we have not yet provided the domestic comforts to which it is habituated. The suggestion, at least, is worth studying, and the association still has these fish under culture, not being convinced of their unsuitability for inclosed waters.

LONDON, ENGLAND, *April*, 1887.

6.—RAPID GROWTH OF CARP DUE TO ABUNDANCE OF FOOD.

By JOHN H. BRAKELEY.

The European carp in becoming naturalized in this country has changed its habits in several important particulars. Instead of hibernating for several months with its nose in the mud, as in Europe, here it does this for a very short time, if at all, even as far north as the Middle States. The eggs hatch here in from four to seven days, according to the temperature of the atmosphere, while in Europe it requires from twelve to twenty. Here it readily takes the bait when skillfully presented, while it is said not to bite at the hook in its native land. So, in becoming Americanized, it has become quite a different fish in habit, if not in form.

The rapidity of growth, too, which characterized many of those distributed by the U. S. Fish Commission during the first four or five years seemed to foreshadow another important change of habit. It was supposed that the waters of this country were more favorable for its development than those of its native land. But in this, I fear, we are doomed to disappointment. Further experience has shown that this remarkable growth of which we hear so much, and of which there are many examples on record, was due to the abundance of food with which the carp were supplied, rather than to other causes. The small number furnished by the Government to each applicant—usually not over twenty—were frequently placed in large ponds, and often at the close of the first summer the fish had reached a weight of from 1 to 2 pounds apiece, and by the end of the second summer from 4 to 5 pounds, and in some instances their growth far exceeded this. But now, since they have multiplied so that we can fully stock our ponds, their growth is much less rapid. In the autumn of 1884 the writer placed a little over 2,500 carp, then one summer old and much larger than their parents when received from the Fish Commission, in a 5-acre pond. In the following autumn they were found to average about 11 ounces each; and last autumn, being the close of their third summer, they fell a little short of a pound apiece, and this, too, with the number in the pond reduced about one-fourth. In another pond of about half the size the growth was no more rapid.

The rapidity, however, with which they grow when supplied with an abundance of food is truly wonderful. I know of no animal—beast, bird, or fish—that will make as large and rapid growth on the same amount of food as the carp, especially in its first and second year. This would seem to indicate that artificial feeding is the natural remedy for slow growth. The few experiments I have made in this direction have yielded very satisfactory results, and I propose feeding on a much larger scale during the coming season than heretofore.

BORDENTOWN, N. J., *February* 15, 1887.

7.—BROWN TROUT IN AMERICA.

By FRED MATHER.

In July, 1886, Mr. Amsden, a banker, of Rochester, N. Y., sent to Mr. E. G. Blackford, of Fulton Market, a brown trout which weighed, on its receipt by Mr. Blackford, 3 pounds. It was taken in Allen's Creek, Monroe County, New York, a tributary of the Genesee River, which receives the famous Caledonia Creek, on which the hatchery of the New York fish commission at Mumford is placed. This fish must have been one which was hatched at the New York station in March, 1883, from eggs sent there by me. These eggs were the first which were received in America, and came to me as a personal present from my friend, Mr. von Behr, president of the Deutscher Fischerei-Verein, whose headquarters are in Berlin, and consequently the fish was about three years and three months old.

At the time that these eggs were sent from Germany Mr. von Behr advised me that there were two kinds of them, not species, nor even varieties, but merely from different waters. One kind, the larger eggs, were from trout inhabiting deep lakes, while the smaller kind were from the mountain streams. These kinds are probably analogous in respect of size to the *fontinalis* of the Rangeley Lakes of Maine and those of our other eastern American waters, as near as I understand the case. I sent to the Caledonia station eggs of both kinds, and this fish, which was taken in Allen's Creek, is probably one that escaped from the hatchery, unless a plant had been made in the creek.

In the ponds now under my charge at this place, we reserved some of these first importations, but lost the greater portion of them from various causes. The station was then new and the waters were infested with eels, which have since been kept down as far as possible, and, while we raised several thousand to be a year old, we lost the most of these by their jumping from the pond they were confined in, an event which has been previously recorded in the publications of the Fish Commission. Of the few that were left there was one which was somewhat larger than its fellows, and proved to be a male fish, and was named "Herr von Behr," in honor of my German friend. In October, 1886, when it was three and a half years old, we took it from the pond and placed it in an aquarium in the hatchery, which had a good flow of running water, in order to show it to the New York fish commissioners, who were expected the next day. In the morning the fish was dead, and it now reposes in alcohol, where its size can be admired by visitors. Its weight was 3½ pounds plump, or at the rate of 1 pound a year.

Mr. James Annin, jr., proprietor of the trout ponds at Caledonia, N. Y., writes that the growth of the brown trout in his ponds is greater than that of the native brook trout.

Mr. A. D. Frye, of Bellmore, Long Island, writes me under date of March 27, 1887, as follows: "Two years since I applied to you for some brown trout to stock a public stream, called Newbridge Creek, at this place, and you furnished them. I have by inquiry learned that last summer some of these fish were taken which weighed three-quarters of a pound."

According to this, these fish could not have been more than one and a half years old; and from my experience I think that the brown trout, as it is called in England, and which is the common brook trout of Europe (*Salmo fario*) is a quick-growing fish, which is destined to become a favorite in America when it is thoroughly known. I have taken this fish with a fly, and consider it one of the gamiest, in fact, *the* gamiest, trout that I ever handled with a rod. I will state, however, that angling friends who have had more extended experience in European fishing than I have say that the Loch Leven trout is a gamier and better fish than the brown trout, but I have had no experience with the Loch Leven fish further than to hatch it. I believe that the brown trout will be found to be a better fish, taking it all around, than our own native *fontinalis.* The reasons for this belief are: (1) It is of quicker growth; (2) it is gamier; (3) except in the breeding season, when the males of *fontinalis* are brilliantly colored, it it fully as handsome; (4) from what I can learn I incline to think it will bear water several degrees warmer than *fontinalis*, and therefore it is adapted to a wider range.

COLD SPRING HARBOR, N. Y., *April* 20, 1887.

8.—THE SPONGE FISHERIES OF FLORIDA.

By J. G. RUGE.

These fisheries give employment to the owners and crews of over three hundred vessels of from 5 to 50 tons burden. They are carried on with some risk from the weather, and at times with much hardship. Each vessel is fitted out for a trip of about four to eight weeks, carrying from two to five dinghies and a crew of five to twelve men; and makes two trips a year, usually in spring and winter, the latter being the best catch. The position of the sponge as it grows on the bottom is ascertained by means of the water-glass, which is a simple bucket with a glass bottom in it, through which when placed in the water one can readily make out articles at the depth of several fathoms.

The Florida sponges are chiefly of four sorts: Sheepswool, velvet, reef, and glove. The sheepswool is the most valuable. It requires about five to six years for a sponge to grow to 8 inches in diameter, and about three years to make 6 inches. The warmer the winter (which makes the water warmer) the faster they grow. The fishermen soon learn by experience to distinguish the grades before taking them.

Owing to the clearness of the water they are able to do this, but rarely beyond the depth of 35 feet, as that is about the limit that can be reached by the naked eye; and, besides, the weight of the poles of this length (which weigh about 30 pounds, with an iron four-prong hook on the end) is as much as a man can handle. The deeper the fishing the greater is the skill required, and it is a rare thing to find a fisherman so active and muscular as to handle successfully a 40-foot pole.

The sponges when first caught resemble heads of decayed cabbage. When taken from the water they are thrown on the deck of the vessel and left long enough for the animal matter or sarcode which they contain to decompose. They are next placed in pens or "crawls" on the beach, where the ebb and flow of the tide-water washes out the dead matter. After several days they are thoroughly cleaned by the fishermen by beating and scraping, and are then placed on strings and allowed to remain on the shore away from the water, where they are more or less bleached by the action of the sun and dew. They are then ready for market, when the vessels take their catch on board and proceed to town to sell them.

The sponges are graded in the markets by the different buyers as their judgment and wants require, in order to make a value. The buyers make sealed bids for the sponges, which are not sold by the pound but by the lot, and this to the uninitiated is "buying a cat in the bag." If the catch is a fair one, each man will receive as his share from $60 to $125, while the vessel gets one-third of the total net earnings. After the buyers procure their lots they assort the sponges in different sizes and grades, after removing therefrom bits of rock, shell, or any other foreign substance that may be present. This is done by beating the root of the sponges with mallets on a wooden block. The only impurities of sand and other substances are in the root or base of the sponge, as sand is as foreign to the body of a natural living sponge as it would be in the flesh of a fish or animal. Sponges are packed in bales of from 25 to 60 pounds in weight.

A pure sponge is free from all rock, sand, or any material used as loading or bleaching. Some few years ago sponges were much lower in price, when the Florida sheepswool was not appreciated as it is now. Prices have continued to advance slowly, and owing to the extreme cold of last winter all the sponges inside the depth of 20 feet were killed, thus making the stock scarcer. This caused another advance, but there is a limit in prices, which is now attained, as the Cuban and Bahama sponges are used as a substitute for many purposes by reason of their lower price.

The present wholesale price is high enough to stimulate the adulteration of the goods, for which purpose several substances are used, such as glycerine, sand, lime, marble dust, and litharge. The glycerine and sand are not in the least injurious and add the least weight, while the lime bleaches and adds a greater weight than the sand. Marble dust is heavier and is retained in the pores better than either sand or lime, while litharge is the heaviest and more like the natural color of the sponge than either of the other articles used. It fills the pores better and there is less chance of detecting its use than that of the other substances, but it is highly injurious. It is frequently used in increasing the weight of sponges to such an extent as to reduce the price from 50 cents to $1 per pound. It will thus be seen that dealers and consumers need to be constantly on their guard in purchasing sponges, or to buy only of the most reputable houses. Whenever sponges purporting to be pure or natural are offered below the ruling market price of reputable houses, there is good cause for suspecting them to be adulterated.

APPALACHICOLA, FLA., *May* 5, 1887.

9.—STATISTICS OF THE FISHERIES OF THE PROVINCE OF BRITISH COLUMBIA FOR 1886.

By THOMAS MOWAT,

Inspector of the Fisheries.

Statistics of vessels, nets, establishments, and men engaged in the fisheries of British Columbia during 1886.

13 steamers and steam auxiliaries, from 3 to 60 tons	$126,000	
16 schooners, from 40 to 80 tons		
18 sloops, from 1 to 12 tons		
994 fishing boats	52,465	
196 fishing canoes, cedar		
64 flat-boats and scows	7,615	
		$186,080
1,066 salmon nets, 332,220 yards	123,690	
2 herring seines	600	
36 herring nets	4,500	
65 fish seines	13,375	
14 eulachon nets	1,700	
		143,865
25 salmon canneries, estimated value	449,500	
1 oil factory, Queen Charlotte Islands	10,000	
1 floating cannery and oil factory	60,000	
Various salting stations	20,000	
Ice-houses and buildings for the shipment of salmon in ice	3,000	
		542,500
Total value		872,445
Sailors		167
Fishermen		3,608
Native hunters		291
Shoremen		2,145
Total number of men engaged		6,211

Yield and value of the fisheries of British Columbia during 1886.

Kind.		Quantity.	Value.
Salmon, salted	barrels	3,006	$25,551
Salmon, kippered	do	50	600
Salmon, fresh	pounds	825,600	57,792
Salmon, smoked	do	22,700	3,405
Salmon, canned, cases of 4 dozen 1-pound tin cans, each	cases	161,270	838,604
Sturgeon, fresh	pounds	114,900	5,745
Halibut, fresh	do	81,000	8,100
Haddock, fresh	do	55,000	2,750
Herring, fresh	do	38,000	1,140
Herring, smoked	do	4,500	900
Smelts, fresh	do	19,000	760
Trout, fresh	do	30,750	3,075
Eulachons, fresh	do	44,000	2,640
Eulachons, smoked	do	1,900	380
Eulachons, salted	barrels	80	800
Assorted fish	pounds	173,800	8,690
Eulachon oil	gallons	200	200
Dogfish oil, refined	do	20,000	10,000
Dogfish, seal, and porpoise oil	do	25,000	10,000
Herring oil	do	740	296
Sardines			500
Crabs and prawns			2,500
Oysters, native	barrels	300	2,100
Clams and other shell-fish			3,000
Fur-seal skins	number	38,907	389,070
Hair-seal skins	do	3,000	2,250
Sea-otter skins	do	25	1,500
Fish sold in markets, not including New Westminster			125,000
Estimated consumption by Chinese laborers on Canadian Pacific and Island Railway and other places			70,000
Total			1,577,348
Estimated consumption by Indian population, as previously computed and revised:			
Salmon	$2,732,500		
Halibut	190,000		
Sturgeon and other fish	260,000		
Fish oils	75,000		3,257,500
Grand total of approximate yield			4,834,848

Comparative value of yield in 1885 and 1886, exclusive of Indian consumption:

Total in 1886	$1,577,348
Total in 1885	1,078,038
Increase in 1886	499,310

From the Fraser River hatchery, in British Columbia, last season there were deposited 2,625,000 fry; and by March 15, 1887, the hatchery will be able to distribute 4,500,000 fry, all of the quinnat and suckeye species (*Oncorhynchus chouicha* and *O. nerka*).

NEW WESTMINSTER, B. C., *February* 25, 1887.

10.—AN ACT FOR SECURING STATISTICS OF THE EXTENT AND VALUE OF THE VESSEL FISHERIES OF THE UNITED STATES.*

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That whenever the papers of any vessel of the United States of over five tons burden, engaged in the capture or transportation of any kind of cetacea, fish, shell-fish, crustacea, sponges, or any other products of the sea, rivers, or lakes, whether said vessel be enrolled or licensed for either the fisheries or the coasting trade, shall be surrendered or shall have expired, the owner or agent of said vessel shall furnish to the collector of customs for the district in which the papers are to be surrendered or renewed, or to his duly authorized representative, an accurate and detailed report of the quantities of fish, shell-fish, crustacea, sponges, oil, whalebone, ivory, skins, and other primary and secondary products of the fisheries taken or transported by the crew or crews of said vessel during the period that may have elapsed since the last issuance or renewal of the papers under which the vessel has been sailing, specifying therein the quantity of each of the different kinds of fish and other products, the locality where obtained, the quantity taken within three miles of the mainland or islands of the United States, or of the mainland or islands belonging to other countries, and such other particulars as may be required by the Secretary of the Treasury; and if at any time the vessel shall change ownership, the former owner or agent shall, prior to the transfer of said vessel to her new owner or owners, make out and deliver to the collector of customs at the former home port of the vessel a full and accurate report, as above described, for such portion of the year as may have elapsed between the issuance or renewal of the last papers and the date of sale, evidence from said collector of the receipt of the same being required by the collector in the district into which the vessel has been brought; and if any owner or agent of any vessel employed as above described shall fail to deliver such record to the proper collector of customs, or his duly authorized representative, covering the period beginning with the issuance or renewal of the last papers and ending with the date of proffered surrender of the papers or application for their renewal, which in no case shall exceed one year, or, in case of sale, prior to the transfer of the vessel to her new owners, said vessel shall be debarred from receiving a new license, any existing law or laws to the contrary notwithstanding, until such record or statement shall have been produced; and the owner or agent failing to conform to these requirements shall be liable to a penalty of two hundred dollars, which may be collected and distributed in the same manner as are fines for the violation of the customs-revenue laws; and the form of such record or report shall be prescribed by the Secretary of the Treasury, and such records shall be returned within thirty days by the proper collectors of customs to the Secretary of the Treasury; and the pecuniary penalty herein described shall be subject to remission or mitigation by the Secretary of the Treasury if, upon investigation, he shall be satisfied that it was incurred without wilful disregard of law; and any law or laws now in force and authorizing the issuance of documents to vessels shall remain inoperative in the case of vessels above described until such time as the owner or agent shall have complied with the requirements of this act.

---

* This passed the Senate on February 8, 1887. In the House of Representatives on February 10, it was read twice and referred to the Select Committee on American Ship-building and Ship-owning Interests. Congress finally adjourned without passing the bill.

SEC. 2. That the master of any vessel of the United States under permanent enrolment, employed in the whale, seal, or other fisheries, whenever landing all or any portion of his cargo within the limits of the United States, shall furnish to the collector of customs, or his duly authorized agent, for the district in which all or any portion of said cargo may be landed, the same information and particulars as may be required by the Secretary of the Treasury from the owners or agents of vessels licensed for the fisheries or the coasting trade and employed as above described; the figures to include the actual quantity of the various products landed which may have been obtained by the crew or crews of said vessel in their capacity as fishermen, and, in separate entry, the quantity of each of the various products obtained by the above-named crew or crews that may have been landed in foreign ports, or transferred to other vessels at sea for the purpose of being landed by them, during the period that may have elapsed since January one, one thousand eight hundred and eighty-five, or after one report shall have been made since the last report covering the operations of said vessel was furnished; and he shall, further, furnish separate reports of all products secured by the crew or crews of other vessels, which may have been transferred to his vessel for the purpose of being landed by him, either in American or foreign ports, during the period above described, mentioning separately the information for each vessel, accompanied by the name and home port of said vessel; and if the master of any vessel sailing under permanent enrolment, and employed as above described, shall fail to deliver such record to the proper collector of customs, or his duly authorized representative, within twenty-four hours of the landing of the portion or portions of the cargo as above described, the papers of the vessel shall be forfeited, and it shall be the duty of said collector of customs to take possession of the same and to forbid the issuance of any others, any existing law or laws to the contrary notwithstanding, until such report shall have been furnished; and the master failing to comply with said requirements shall be liable to a penalty of two hundred dollars, which may be collected and distributed in the same manner as are fines for the violation of the customs-revenue laws; and such record shall be returned within thirty days by the proper collector of customs to the Secretary of the Treasury; and the pecuniary penalty herein described shall be subject to remission or mitigation by the Secretary of the Treasury, if, upon investigation, he shall be satisfied that it was incurred without wilful disregard of law; and any law or laws now in force and authorizing the issuance of documents to vessels shall remain inoperative in the case of any of the aforesaid vessels until such time as the master shall have complied fully with the requirements of this act.

MARCH 4, 1887.

11.—LOCH LEVEN TROUT INTRODUCED IN THE UNITED STATES.

By CHARLES W. SMILEY.

The first importation of Loch Leven trout eggs to the U. S. Fish Commission, and, so far as I am informed, to the United States, was made through the courtesy of Sir J. Ramsay Gibson Maitland, Bart., the proprietor of the Howietoun fishery, Stirling, Scotland. This trout has succeeded finely in streams in the south of England, though lacking the superb flavor of those bred in Loch Leven.

On November 12, 1884, a lot of Loch Leven trout eggs was taken at the Howietoun hatchery from fish which were hatched in 1876. These were packed under the direction of Mr. Guy in six cases, as follows: Each box contained six trays, and each tray three layers. Each layer contained 950 eggs, making a total of 102,000. On top of each box was a tray for ice and containing moss or sawdust. In unpacking, the moss in the trays which had been felted by machinery is rolled back (not lifted), and if this is done carefully no eggs adhere to the moss. The muslin on which the eggs lie is then lifted out by two persons holding the four corners tight. It was not intended that the eggs should be repacked at New York. If the eggs had remained in the hatchery and hatched normally they would mature in seventy-two days or about the 22d of January, but with the cold packing it was believed that the hatching would be retarded until the first week in February.

The six cases were sent to Liverpool by way of Glasgow, the latter place being only one hour distant from Howietoun. At Liverpool Messrs. Henderson Brothers took charge of the cases and consigned them, freight free, per steamship Furnessia, of the Anchor line. On January 1, 1885, the Furnessia arrived in New York Harbor, but the custom-house being closed in consequence of its being New-year's Day nothing could be done to remove the eggs until January 2. Mr. Fred Mather had already effected an arrangement with the New York custom-house, with the aid of Mr. George Hilliar, for the prompt delivery of the eggs in order that he might promptly transfer them from the ice-room of the Furnessia to the Cold Spring Harbor hatchery. The eggs reached the hatchery at 8 o'clock that evening, January 2, where they remained over Sunday. On opening, the eggs were found to be in excellent condition, there being but a small number dead and but few indented. The method of packing was found to be most admirable, and the boxes, 3 by 2 by 2 feet, were of the most substantial nature. Each contained a 3-inch air space between the box and lining. The lining had been charred. There was no trace of fungus in the lot.

The trays were about 8 inches square and 5 inches deep. This arrangement economizes space and expense as well. The boxes were used by Mr. Mather a few days later for forwarding whitefish eggs to Germany and Switzerland. On Monday, January 5, Mr. Mather sent 10,000 eggs to General R. U. Sherman, of the New York State commission, and the remainder to the Northville station. None were retained at the Long Island hatchery, because they had been supposed to be a trout requiring the deep waters of lakes, a belief which was afterward found to be incorrect, as it was learned that the fish had been introduced into the streams of England. Mr. Clark telegraphed their safe arrival at Northville on January 7, and made the following distribution:

1885.		
Jan. 29.	To E. B. Hodge, Plymouth, N. H., for Sunapee Lake	5,000
Feb. 3.	To A. W. Aldrich, Anamosa, Iowa	20,000
Feb. 3.	To R. O. Sweeny, Saint Paul, Minn	20,000
Feb. 4.	To Charles G. Atkins, for lakes in Maine	10,000

The remainder were retained by Mr. Clark to be hatched at Northville. Between April 10 and April 23 he distributed them as follows:

To Michigan fish commission	10,000
To L. S. Hill, Grand Rapids, Mich	5,000
To G. H. Dalrymple, Grand Rapids, Mich	1,500
To Crooked Lake, Northern Michigan	20,000
Retained to be reared at the hatchery	7,000

The 10,000 eggs assigned to General R. U. Sherman were forwarded to the Bisby Club hatchery, situated at the first Bisby Lake in the Adirondacks, town of Wilmurt, Herkimer County, New York. General Sherman is president of the Bisby Club. Under date of January 24, 1885, Mr. Henry Studor, the keeper of the Bisby Club House, wrote: "The Loch Leven trout eggs which came from Scotland are a splendid lot. I do not think that I have picked out fifty bad ones. In the course of ten days they will begin to hatch. The young fish can be plainly seen in the shell." General Sherman writes that the eggs hatched successfully, producing vigorous fry, which were planted in the Second Sylvan Pond, a sheet of 30 acres, with pure spring water and well supplied with insect and minute crustacean food. It also contains brook trout and dace, but no other fish.

The eggs sent to Mr. E. B. Hodge arrived in good condition, hatched well (loss only 118), and about 3,400 fry were planted June 1 in Sunapee Lake, Sullivan County, New Hampshire. Concerning them he wrote, March 18, 1887:

"This is one of our largest lakes and has an elevation of about 1,200 feet above sea level. It is a natural trout lake. It is 9 miles in length and from ½ to 3 miles wide. I do not know of their having been seen since, and from so small a plant in a lake of this size it is hardly time to expect their appearance. We shall make a plant this year in this lake of 20,000 Loch Leven trout fry."

The 20,000 eggs sent to the Anamosa hatchery arrived in splendid order, only four being dead. They hatched well, and on April 3 the fry were taken to Spirit Lake, Iowa, to be put into West Okoboji Lake, one of the chain of lakes in Dickinson County, with very clear and very deep water. It is about 6 miles long and 2 miles wide, and is considered the only suitable lake in the State for these trout. Mr. A. A. Mosher, who deposited the fish, says that nothing has yet been heard from them, the long mosses and aquatic plants, which rise from 2 to 10 feet from the bottom of the lake, making an excellent hiding-place for them.

The 10,000 eggs sent to Mr. Atkins went, by some mistake, to Grand Lake Stream, and were reshipped to Bucksport, Me. On arrival there it was found that they were partly frozen, which caused a loss of 1,575 eggs. The total loss was about 3,000. Those that hatched were planted in Branch Pond or its tributaries, within the city of Ellsworth, on May 4, 1885. Branch Pond is a tributary of Union River, in Hancock County, Maine. Up to February, 1887, nothing had been seen of the fish. In the spring of 1886 Mr. Atkins angled for them without success.

The 10,000 sent to the Michigan fish commission were planted in two small lakes in Clare County, Michigan, the headwaters of the Tobacco River.

The 5,000 eggs sent to Mr. L. S. Hill were hatched and planted in streams and lakes tributary to Ball's Lake, Bulton's Lake, and Buck Creek, a few miles out of Grand Rapids, Mich., and some were placed in a small body of water since turned into a trout pond. All seemed to be doing well in the fall of 1886, and in the spring of 1887 many were seen in the trout pond.

In March, 1887, Mr. Clark reported that of the 7,000 fry retained at the Northville hatchery about 2,500 remained in good condition and were doing well, no perceptible losses having occurred since four or five months after hatching.

Either no report has been given or nothing definite is known of those sent to Messrs. Sweeny and Dalrymple, and to Crooked Lake, in Northern Michigan, where the plant was made by the Flint and Pere Marquette Railroad.

Concerning the hatching of these eggs Mr. Maitland wrote: These eggs differ from the *fontinalis* in requiring a much larger supply of water, and it is absolutely necessary that they in no case be laid down so as to lie one above another. The water over them should not be more than half an inch, with a supply of 2 gallons per minute. A test experiment of this was made and has been repeated with the same results for seven successive years. They asphyxiated in 6 inches of water, temperature at 45° F.; date, one week before hatching; size of trough, 7 feet by 20 inches. Under the same circumstances, *fontinalis* eggs would hatch perfectly.

In Loch Leven, says Mr. John D. Quackenbos, writing from that lake on June 24, 1886, these trout are found upon the shoals all summer, and afford rare sport to the angler. As fighters they far surpass the *Salvelinus fontinalis*, and no fish can surpass them in delicacy of flavor.

They also attain an extraordinary size, the largest specimen on record weighing nearly 18 pounds; but the average size of fish ordinarily taken with a fly is from 1 to 1½ pounds.

The Loch Leven trout (*Salmo levenensis*) is closely allied to and by some has been claimed to be identical with the European or brown trout (*Salmo fario*), but this view is not shared by Dr. Francis Day and Sir Gibson Maitland, who classify the *Salmonidæ* as follows:

Sub-genus A.

Deciduous vomerine teeth—Salmones.

a. About eleven rows of scales in an oblique line from adipose dorsal fin to the lateral line.

1. *Salmo salar*..............................The salmon.

b. Fourteen or more rows of scales in an oblique line from adipose dorsal fin to the lateral line.

2. *Salmo trutta*..............................The sea trout.

VARIETIES.

(*a*) *Salmo albus*, under which Day includes *S. eriox* or *S. brachypoma;* in other words, bull trout.
(*b*) *Salmo cambricus*, commonly called the sewen.

2 A. *Salmo levenensis*..............................The Loch Leven trout.
2 B. *Salmo fario*..............................The common trout.

VARIETIES.

(*a*) *Salmo orcadensis*..............................The Loch Stennis trout.
(*b*) *Salmo ferox*..............................The ferox.
(*c*) *Salmo cornubiensis*..............................The Cornwall trout.
(*d*) *Salmo nigripinnis*..............................The black-finned trout.
(*e*) *Salmo estuarius*..............................The Galway sea trout.
(*f*) *Salmo stomachicus*..............................The gillaroo.
(*g*) *Swaledale trout.*
(*h*) *Ciassapuill trout.*

Sub-genus B.

Vomerine teeth restricted to near the head of that bone—Salvelini.

3. *Salmo alpinus*..............................The alpine char.

VARIETIES.

(*a*) *Salmo perisii*..............................The Welsh char.
(*b*) *Salmo willughbii*..............................The Windermere char.
(*c*) *Salmo killinensis*..............................The Loch Killin char.
(*d*) *Salmo grayii*..............................The Lough Melvin char.
(*e*) *Salmo colii*..............................The Lough Eske char.

4. *Salmo fontinalis*..............................The American char.

All British char are varieties of 3, *S. alpinus*. The American brook trout ranks as *S. fontinalis*.

The following facts are furnished by Sir Gibson Maitland:

"Loch Leven is a lake of between three and four thousand acres, fully one-half of which averages a depth of 12 feet. The lower end and center of the lake vary from 40 to 80 feet in depth. The summer temperature is between 50 and 60 degrees Fahrenheit; the winter, probably not below 40 degrees; the deeper parts, probably above 46 degrees.

"Until the beginning of the present century there was free access to the sea, and probably a few centuries ago the Loch Leven trout was thoroughly migratory. About fifty years ago the loch was reduced to its present size, 1,000 acres being drained, the surface lowered 6 feet, and sluices constructed at the outlet for the accommodation of mills on the River Leven below. The *S. levenensis* is found in the River Forth, in Loch Lomond, and other lakes of the west coast of Scotland, and also those of the northwest of England. It crosses readily with *S. trutta* (sea trout) and *S. fario* (common trout); the offspring are fertile. It hybridizes with *S. salar*. The offspring of *S. levenensis* (female) and *S. salar* (male) have hitherto been sterile. Those I have are now in their fourth year. The offspring of *S. salar* (female) and *S. levenensis* (male) which I have are as yet too young to determine sterility, but this cross is much easier made and the ova more prolific than in the former.

"The Loch Leven trout still retains many characteristics of a sea-going salmonoid, such as the parr marks, the silvery smolt livery, the forked-tail grilse stage, with its small proportion of spawners, diminutive eggs (40,000 to a gallon), and tender, delicate embryos; and its mature state, with a square tail, strongly developed hook on the under jaw of the males, large eggs (27,000 to a gallon), producing strong, well-formed, vigorous embryos. The practical difference between *S. levenensis* and *S. fario* is that the former has a much larger number of cæcal appendages and a stronger stomach, enabling it to crush the *Limnia pereger*, on which it largely feeds."

At a meeting of the Linnean Society of London, in January, 1887, Dr. Francis Day read a paper on the Loch Leven trout, in which he said: "These fish are known by their numerous cæcal appendages, and up to their fourth or fifth year they are of a silvery gray, with black but no red spots. Subsequently they become of a golden purple, with numerous black and red spots. Undergrown ones take on the color of the brown trout [common English brook trout, *Salmo fario?*]. Remove these fish to a new locality, and they assume the form and color of the indigenous trout. In 1883 a salmon parr and a Loch Leven trout were crossed, and the young have assumed the red adipose dorsal fin, and the white-edged margins to the dorsal and ventral, also the orange edges to both sides of the caudal—all colors which are found in the brook trout, but not in the salmon or Loch Leven trout. The maxilla in this form not extending to behind the eye, the absence of a knob on the lower jaw in old breeding males, and the difference in the fins from those of *Salmo fario*, were shown to have been erroneous statements."

WASHINGTON, D. C., *May* 5, 1887.

Vol. VII, No. 3. Washington, D. C. May 26, 1887.

12.—NOTES UPON FISH AND THE FISHERIES.

[Extracted from the official correspondence and compiled by the editor.]

THE EEL IN WESTPORT RIVER.—During the past few years the people along Westport River have been fishing for eels with great success, by means of trawls baited with live mumfres or mummichogs, several hooks often being set on one trawl. These eels are evidently different from those that bed in the river for the winter. I think they must be the same kind that run out of the fresh and brackish ponds along shore when we have the first severe frosts in the fall. These eels strike up the river about as soon as the ice is gone, the latter part of March or early in April, and are taken on the trawls, while river eels are still in the mud and are caught with spears. Should the river be frozen above and then break up and come down with the tide, or should snow and slush chill the water, then the trawl eels move down stream and are caught only on the lower lines of hooks, while the bedded eels are still to be caught up the river in the mud. The trawl eels are in splendid condition, while Westport River bedded eels are noted for being most always poor and thin. The catch of herring this spring in Vineyard Sound, around Buzzard's Bay and Cape Cod, has been greater than for years, which I think is owing to our having had such heavy rains as to freshen the water at the mouths of rivers and brooks for a long way out to sea, thus attracting them. [Willard Nye, jr., New Bedford, Mass., May 6, 1887.]

MACKEREL, CODFISH, HERRING, ETC., OFF NORTHEASTERN MASSACHUSETTS.—Mr. James W. Elliott, keeper of the Plum Island life-saving station, near Newburyport, Mass., in a letter dated April 28, 1887, gave the following note on the fisheries near that station:

"During 1886 mackerel were first caught near this station about July 1, and the last were taken about October 15. There were no large shoals, as usual, seen near here during the season. Only a few were taken in seines within a radius of 8 miles of this station, but small lots were taken with hooks almost every day while the season lasted.

"But few codfish were taken until November, when a large shoal came into the bay, and the fish were taken daily in large quantities up to the last of April, most vessels getting large fares. None were caught at any time within less than 3 miles of the beach.

"Herring were scarce here, and but few were taken, although our local fishermen made strong efforts to capture them. It is reported that large quantities were taken off Cape Ann (11 miles from this station) from August 1 to December 1.

"No bluefish or menhaden, so far as I know, have been seen hereabouts during the past season, nor have other marine animals been noticed, with the exception of an occasional finback whale blowing off shore."

MACKEREL ON THE COAST OF FLORIDA IN WINTER.—In a letter which I received from Capt. Silas B. Latham, of Noank, Conn., dated April 2, 1887, he mentions the fact that he had seen mackerel during the past winter while fishing for red snappers off the east coast of Florida, and he stated that there were two species, one of which he thought was the common mackerel (*Scomber scombrus*) and the other the chub mackerel (*Scomber colias*).

I was interested to learn further details relative to the occurrence of mackerel in that region, and therefore wrote to Captain Latham. I have just received from him a letter dated April 10, in which he writes as follows:

"The mackerel I saw were thrown up by large snappers, and they had not been dead long, as they were in a perfect state. They were 'spike' size. One was our common species, and the other was what is called a 'chub mackerel.' I have often seen them there, but have never seen any larger specimens than the size named. I have seen them off Saint John's River and off Mosquito Inlet, Florida. I have seen schools of small fish that I think were mackerel, but they might have been some other kind of fish." [Capt. J. W. Collins, Washington, D. C., April 12, 1887.]

RANGE OF THE RED SNAPPER.—In a letter which I received from Capt. Silas B. Latham, of Noank, Conn., dated April 10, he says there is no doubt in his mind that fish of the red snapper species can be caught inside of the western edge of the Gulf Stream as far north as Cape Lookout, and possibly even farther north. He says: "The captain of a coaster told me he was becalmed once south of Lookout, in 35 fathoms, and he caught 35 red snappers, and would have taken lots more if the current had not swept him off." [Capt. J. W. Collins, Washington, D. C., April 12, 1887.]

FATAL INJURY INFLICTED BY A STARFISH.—A fisherman at Port Discovery, named Charles Lambert, met with a singular accident which resulted in his death. A starfish got entangled on his hook, and while taking it off one of the sharp little spines or prickles pierced the skin of his left hand between the fingers. He paid no attention to it, but soon it festered, his arm began to swell, blood-poisoning ensued, and the man died in the Marine Hospital here yesterday. It is the first time I have heard of such an instance. I know that the spines of the sea-urchin will produce sores if they are broken off in one's flesh, but for a flabby starfish to injure a person in such a manner seems unaccountable. [James G. Swan, Port Townsend, Wash., April 10, 1887.]

ASSIGNMENTS OF EGGS OF BROWN TROUT AND SAIBLING, SEASON OF 1887.—To the courtesies of Herr E. von Behr, president of the Deutscher Fischerei-Verein, and Herr Max von dem Borne, of Berneuchen, Germany, the U. S. Fish Commission is indebted for several consignments of eggs of the brown trout (*Salmo fario*) and saibling (*Salmo salvelinus*). The number received, their condition as reported on arrival, and the assignments made of the eggs are given below:

From Deutscher Fischerei-Verein in exchange.		From Herr Max von dem Borne, Berneuchen.		Summary.	
Brown trout.	Saibling.	Brown trout.	Saibling.	Brown trout.	Saibling.
50,000 †13,000	20,000 †5,000	8,000 14,500	20,000 †8,000	*37,000 ‡22,500	*15,000 ‡12,000
37,000	15,000	22,500	12,000	59,500	27,000

* Von Behr. † Loss. ‡ Von dem Borne.

Which were distributed as follows:

	Brown trout.	Saibling.
Pennsylvania fish commission	10,000	
Wytheville, Va	10,000	
F. N. Clark, Northville, Mich	20,000	15,000
Cold Spring Harbor, N. Y	9,500	9,000
E. B. Hodge, Plymouth, N. H	5,000	3,000
Central station, Washington, D. C	5,000	
Total	59,500	27,000

Of the last shipment of 50,000 brown trout eggs forwarded by Von dem Borne 30,000 were dead on arrival, and the balance will probably prove a total loss. [M. McDonald, April 28, 1887.]

DESTRUCTIVE STURGEON FISHING BY CHINESE IN CALIFORNIA.—Mr. R. H. Buckingham, president of the California fish commission, in a letter to Professor Baird from Sacramento, February 12, 1887, speaks of sending a sample of Chinese sturgeon-hooks which were taken from a line 2,000 feet long, having 8,000 hooks attached. These lines were fished by the Chinese in San Pablo Bay, some 20 miles north of San Francisco. This apparatus uses no bait, but is one of the most destructive methods known to catch sturgeon, taking all sizes from 1 pound up.

STRIPED BASS IN NEW YORK BAY AND THE HUDSON RIVER.—Mr. Philip Neidlinger, writing from New York City on March 21, 1887, stated that about May 1, 1885, while walking along the North River from 86th street to about 140th street, he noticed many small striped bass (*Roccus lineatus*), from 3 to 5 inches long, which were being caught with hook and line. In autumn he saw a very few taken, running from ½ to 2 pounds, while small quantities were taken and disposed of in the markets of the city. In the fall of 1886, he took several weighing from ½ to 1½ pounds, and heard of them as being abundant in New York Bay and up the river as far as Tarrytown. He remembers seeing a few years ago striped bass in market weighing 92 pounds, but now one of

35 to 50 pounds is considered a very large fish of this kind. Some time ago there was a law passed to protect this fish during its spawning season, but the law was soon repealed.

JACK SALMON AND BLACK BASS IN THE OHIO AT WHEELING.—Mr. Alex. Q. Eoff, in a letter from Wheeling, W. Va., dated December 29, 1885, said: "During September and October of 1885 there was a much larger run of jack salmon (*Stizostedium vitreum*) and green salmon* (*Stizostedium salmoneum*) here than I ever before knew. Probably as many as 3,500 or 4,000 were taken by hook and line in the immediate vicinity of Wheeling. There seemed to be no particular place for them to gather, as in former years, but wherever a bait was thrown a fish was almost sure to be there. They did not exceed 10 inches in length. The jack salmon were the most numerous, in proportion of about 8 to 3. I have known of large numbers of these fish being caught in seines at the mouth of the Wheeling Creek during the spring season, but never before in the fall. Very few of the black bass of our river have been taken this season. I have seen only three that would weigh from 2½ to 3 pounds, the greater number being from 6 to 10 ounces in weight."

SHAD PLENTIFUL IN CALIFORNIA.—Shad are now so plentiful that they bring only 5 cents per pound in the season, and are found in our bay all the year round. The run this year will be very large, and already the markets are full of them, and fine shad from 4 to 6 pounds are selling from 40 to 50 cents each. [Charles Kaeding, San Francisco, Cal., March 2, 1887.]

SHAD FROM CEDAR KEYS.—In April, 1885, Mr. W. S. Bunting, of Cedar Keys, Fla., sent for identification a fish 15 inches long, which proved to be *Clupea sapidissima*. Several similar specimens have been obtained from Cedar Keys in previous years.

SHAD IN 1885.—The present season (1885) has been a wonderfully productive one in North Carolina, and it is a number of years since shad have been so cheap at this season of the year as they are at the present time. To-day large roe shad have sold at 25 cents each by the hundred, and buck shad at 15 cents each; and from telegrams received to-day there will be a large arrival to-morrow, so that these low prices will remain and possibly even go lower.

The first North River shad was brought to me on Saturday, April 4, and to-day (April 7) a few more have come in. From points farther south, earlier in the season, I have noticed that there has been an increased quantity sent to this market from Florida and Georgia. [E. G. Blackford, Fulton Market, New York.]

---

*Mr. H. B. Miller, writing from Wheeling, W. Va., March 25, 1887, says: The fish which Mr. Eoff calls "green salmon" is the white salmon or blue pike (*S. salmoneum*). This and the gray pike or sauger (*S. canadense*) are called locally "green" or "white salmon" and "jack fish." They have been getting scarce until year before last, when they were found in largely increased numbers, owing, I think, to the Ohio State commission stocking tributaries of the Ohio River with young of these varieties from their lake hatcheries.

SHAD IN THE GULF WATERS.—Dr. Wardell, of Bainbridge, Ga., informs me that an occasional shad was caught last autumn with bait in the Flint River, a branch of the Appalachicola. A few days since I was crossing the Ocklockonnee, in Florida, by means of a ferry, and was informed by the ferrymen that a new fish had made its appearance in the river swimming in shoals, which they described in such a manner as to leave no doubt on my mind that these fish were shad. These men also said that others who had seen them said that they were that fish. [Edward Jack, Tallahassee, Fla., March 7, 1887.]

A few days since a friend of mine caught several small shad at this place at the mouth of Appalachicola River. We never have heard of any such fish being caught here before. [John G. Ruge, Appalachicola, Fla., May 5, 1887.]

PROPAGATING LAKE HERRING OR CISCOS.—Mr. F. M. Baker, writing from Rome City, Ind., on February 7, 1887, said: "We have in some of our lakes in Kosciusko and Noble Counties a small whitefish, figured and described by Prof. D. S. Jordan in the Geological Survey of Indiana for 1874 under the name of *Argyrosomus sisco* Jordan,* which I think might be successfully and profitably bred and planted in all the lakes of Northern Indiana, and would probably be desirable for the lakes of the New England States and New York. They inhabit the deep waters of the lakes, living upon small crustaceans found there; they are not predaceous in their habits, but in the early stages of their growth furnish food for predaceous fishes, and when mature they are an excellent food-fish, weighing from three-quarters to 1½ pounds. Their spawning season is during the latter part of November and first of December, at which period they throng the inlets of the lakes they inhabit, and are taken in vast numbers by nets and spears. With proper appliances for hatching, great quantities of eggs might be obtained from the captured fish when they come out of the deep waters to spawn."

SALMON FORMERLY IN THE CONNECTICUT.—The following is extracted from Mr. Jabez H. Hayden's Centennial Sketch of Windsor Locks:

"There is a very common impression at the present day that shad were more esteemed as an article of diet than salmon, because of the tradition that a man could not buy shad without taking salmon with them. I once asked the late Samuel Denslow what that tradition grew out of. He said that fish were marketed at the fish-place, and that people came with their teams to get a supply of shad to salt, and they were required to take the salmon caught with them, the price of 1 pound being the same as the price of one shad. ['1781. For 50 shad at 2*d.*: 8*s.* 4*d.*'—Old account-book.] Salmon were so high-priced then that many felt they were a luxury they could hardly afford. As an illustration of the high value put upon salmon he gave the details of the capture of the last salmon he ever knew taken in the Connecticut River; this was about 1805; Mr. Denslow had taken the place of a tardy fisherman and was to have had his share. The salmon weighed 23 pounds. It was sent by a party going to Northampton to sell. It was court week, and there were distinguished men present from Boston, for whom an entertainment was being prepared, and the salmon was sold for $1 per pound."*

---

* This seems to be the lake herring or cisco (*Coregonus artedi*) mentioned in Jordan & Gilbert's Synopsis of North American Fishes, page 301, and the quarto History of Aquatic Animals, p. 541.

Mr. Apollos Fenn agrees with Mr. Hayden about the salting of shad, but inclines to think the salmon were abundant. "My father told me when I was a boy that he and grandfather used to come yearly to the Connecticut River for a supply of shad to salt down, which was then the custom of most farmers up in Litchfield County, and that the fishermen caught so many salmon when hauling for shad that they required every one who bought shad to take a certain number of salmon, or no sale of shad, thus showing that salmon were very plentiful at that time in the Connecticut River. This was from about 1775 to 1810."

CALIFORNIA TROUT.—In May, 1885, Seth Green received a California trout from Crooked Lake which weighed 4½ pounds, he having planted 30,000 young in that lake four years previously. This was only one of several that had been caught.

ROCKY MOUNTAIN TROUT AND BROOK TROUT IN COLORADO.—I have lived in Colorado ten years and have noticed the common trout of that country (*Salmo virginalis*, I believe) almost disappear from all streams in or near the settlements. I believe that the eastern brook trout (*Salvelinus fontinalis*) would do better, and I have expended over $5,000 in its introduction. The weak points in the Rocky Mountain trout are these:

(1) It spawns between May and August, and is therefore out of season in the summer time, when visitors come to the mountains expecting sport and pleasure.

(2) The eggs are deposited during the most dangerous time of year for their safety, and freshets from the sudden melting of snow rip up the spawning beds and destroy the eggs in vast numbers.

(3) The fish is so easily caught, it is so unwary and confiding, that the fish in a moderate-sized stream can be taken out in one season with a hook and line and a grasshopper. Without the modern hereditary instincts of self-preservation, apparently, it cannot hold its own against the fisherman.

(4) It is a poor table-fish at best.

In contrast to these, the brook trout has the following strong points:

(1) It spawns between November and February, and is in season in summer, when most desired.

---

* Fifteen years after the last salmon was caught there were eight fish-places on the west side of the river, where only shad were taken, between Hayden Station and the railroad bridge at Windsor Locks.

(2) The eggs are deposited at the time of year when freshets are unknown, when the spawning beds are protected by surface ice, and the eggs are placed out of danger.

(3) The *fontinalis* is very wary, and has learned for generations to look out for pins and fish-hooks, so that it generally requires some skill to catch this species.

(4) It is a much better table-fish than the Rocky Mountain trout.

My fish ponds are at Manitou Park, 25 miles northwest of Manitou, up the Ute Pass, where I have a large hatching house by a very fine spring, several ponds, an artificial lake of 30 acres, and 12 miles of trout stream, formerly famous for the western trout, but quite denuded of them when I commenced to preserve.

Two years in succession, 1874 and 1875, I got 100,000 eggs of the *fontinalis* from Seth Green, and hatched them without difficulty. After that we had our own fish to spawn, and have spawned them each winter. The streams running through the park are now well stocked with *fontinalis*, and also the lake, which is situated at the lower end of the stream I preserve. They live at peace with the western fish, and don't fight with them even when confined in small ponds. They are quite healthy. In watching both kinds together you always find the *fontinalis* below and the *virginalis* above, each kind keeping together and not mixing up. [William A. Bell, Colorado Springs, Colo.]

RAINBOW TROUT IN VIRGINIA.—W. C. Pendleton, clerk of the supreme court of Virginia, at Marion, Va., wrote to Col. M. McDonald, under date of April 12, 1887, as follows: "This morning a rainbow trout was caught in Staley's Creek, in the corporate limits of Marion, that measured 22 inches in length and weighed 4 pounds." This stream was first stocked with the fry of the rainbow trout in 1883. A number of others of this species have been taken in the same stream and heretofore reported.

RAINBOW TROUT IN ENGLAND.—The Journal of the National Fish Culture Association of England (January 15, 1887) contains an article on rainbow trout by W. Oldham Chambers, from which are taken the following extracts:

"We have a fair number of these fish, weighing about three-quarters of a pound each, at the establishment of the National Fish Culture Association, which are nearly two years old, and were obtained from ova forwarded by the American Government. They were incubated at South Kensington, and the fry were transferred to their present location; but, owing to the lateness of the season at which the ova were received, some difficulty was occasioned in rearing them. On being well established in suitable ponds they grew rapidly, insomuch that at the end of eighteen months they far outstripped in size the *Salvelinus fontinalis*, which, besides being a fast-growing fish, emerges from the ova three months earlier than the *Salmo irideus*. After the two years' experience I have had of the latter, I unhesitatingly pronounce them to be superior to our own species in hardiness and rapidity of growth. The attempts made to acclimatize them to English waters, so far as restricted areas are concerned, have proved successful; and they seemed to become thoroughly naturalized therein immediately on their introduction, proving thereby that the condition of the water, climate, and food are well adapted to their wants. * * * At Delaford Park the fish furnish signs of yielding their ova towards the middle of January. If so, the date of spawning would be about the same time as other species of trout; and thus the fear of extinction through cannibalism, experienced in the United States, need not be entertained, as the fry would be able to protect themselves in the same way as their baby cousins.

"It is not surprising to find that the rainbow trout should show signs of generating so much earlier in this country than abroad, especially at Delaford, where the water is doubtless softer than that in California. Late spawners are generally those that inhabit waters of a low temperature, but if such fish are transferred to warmer climes they alter their nature accordingly. This is precisely the case with the rainbow trout, which have evidently altered their habits and adapted themselves to the altered conditions under which they are now placed.

"The facts already adduced regarding this fish can only be applied to them under a semi-artificial state, as hitherto they have to a great extent been confined in inclosed quarters. A few were turned into the river Colne, and were caught by me in the same locality a year afterwards. This experiment, I hope, will be extended shortly, if they can be raised in sufficiently large numbers to allow of its being done, which I have no doubt about, as the U. S. Fish Commission, through Professor Baird, is willing to forward further consignments of ova. These, in addition to the stock reproduced by the fish in the possession of the Association, will enable us to plant quite a quantity in public waters.

"It is asserted that the rainbow trout is migratory in its habits. As far as I can see at present the reverse is the case. I believe it is not identical in this respect with the *Salvelinus fontinalis*, whose wandering propensities have earned it the rebuke of all men; neither are its requirements the same, the location of the one being uncongenial to the other. Migratory or non-migratory, the rainbow trout would make its mark in inclosed waters or for ornamental purposes. Regarded from a sporting point of view, it would prove an acquisition, as I have on many occasions observed it rising to a fly. I believe it is not considered a game fish in its native waters, and here again it appears to have altered its nature. There is no doubt about it, that the gameness of fish is governed by the condition of the water which they inhabit; therefore, from an angler's point of view, the interchange of species with foreign countries is a great boon, as proved by the case just cited. * * * Moreover, the rainbow trout is more delicate in its appetite than other varieties of *Salmonidæ*, and therefore is not prone to the same temptations to cannibalistic attacks upon its congeners."

FOOD OF THE SALMONIDÆ AT SEA.—An article with this heading was published by Mr. W. Anderson Smith, in No. 1, Vol. I (January 15, 1887) of the Journal of the National Fish Culture Association of England, from which the following abstract is made:

Most fishermen and naturalists know that salmon, while coming up the rivers of Great Britain for the purpose of spawning, do not as a rule seem to take food, while it is well known that the spawned fish are very voracious and do great injury among the young salmonoids which are struggling for existence. It would seem, therefore, that for such large and strong fish to recover after their return to the sea from their period of fasting and exertion they must reach feeding grounds of exceptional richness and extent. The *Salmonidæ* cannot, as a class, be called insectivorous fish, like the herring or mackerel, and their onslaughts on the floating life of the sea of an invertebrate class are only makeshifts, in the absence of the more important food to which they must in reality mainly look. Now, careful observation and the gathering of facts indicate clearly that herring and their young are the food of salmon at sea. One of the most experienced fish-curers of Lewis (the largest island of the Hebrides) declares that in his experience salmon at sea feed upon young herring. Maclaine, of Lochbuy (Isle of Mull), says that once off Colonsay (one of the Hebrides) he came upon large fish leaping out of the water in their eagerness to seize their prey, and that these were found to be salmon chasing herring. On the west of Mull, salmon taken in the fresh water direct from the sea were found to be full to the mouth with young herring. Mr. John Anderson, of Denham Green (Edinburgh), after sixty years' experience in an extensive fish trade, says that the principal food of salmon is the herring and its fry, and that frequently several herring and a score of fry are found in a salmon's stomach along with crustaceans. These and many other observations go to corroborate the suggestion that herring are the great ocean food-supply of the salmon, and lead the *Salmonidæ* to follow them to their haunts. It is certain, however, that a voracious fish will not confine itself to any single species of food; so it seems that salmon feed on sea-mice (*Aphrodite*) and various kinds of crustaceans.

Sea-trout are somewhat different in character from the salmon. They feed voraciously, not only when coming in shore, but even in fresh water. These fish also are frequently taken with their stomachs full of young herring, while they are fond of sand-eels. It is also known that they eat cephalopods freely, as well as crustaceans and annelids.

USE OF BORACIC ACID IN THE ENGLISH FISH TRADE.—The use of boracic acid seems to be bringing about a foreign competition in the fish trade that will make itself felt in the English markets. By its use Norwegian herring can be sold with profit in the English market as Yarmouth or Scotch fish. Indeed, the tables of fish landed that the Board of Trade publish are made up to some extent by foreign fish. The present effect of Norwegian consignments has been so to reduce the price of

Scotch herring that the price they sell for in London will barely realize the carriage. A cran* of herring costs in railway carriage about 15 shillings ($3.65) to get from most of our fishing stations to London; adding porterage and other charges, the cost to get a cran to Billingsgate is 18 shillings or even 20 shillings ($4.38 to $4.86). But 20 shillings per cran is a common price to sell herring at Billingsgate. How, then, are the curer and fisherman to live at these prices? Either railway rates must come down or the Norwegian will drive the English herring out of the market. This does not apply to herring alone, since cod, salmon, and other fish can be sent as well as herring. Norway is not the only place the English fishermen have to dread, as boracic acid will equally enable fish to be brought from America. [From the Journal of the National Fish Culture Association, London, England, January 15, 1887.]

ANNUAL EXPENSES OF THE LOWER COLUMBIA SALMON CANNERIES.—The importance of the salmon industry to Astoria, Clatsop County, and the Lower Columbia River region generally, is tersely illustrated by the following figures, which are a close estimate of the amount of money expended for the season of 1886:

Cost of materials.

Tin plate, 74,000 boxes, at $5.25	$388,500
Salmon twine	205,200
Cotton twine	25,000
Lines	26,600
Leads for lines	7,500
Floats	4,000
Boats, wear and tear, paint, repair, &c	38,000
Tan-bark for nets	1,900
Pig-tin for making solder	50,122
Lead for making solder	10,450
Salt, Liverpool and coarse	2,000
Lacquer	8,550
Turpentine	6,460
Cord-wood	19,760
Hard coal	1,862
Charcoal	15,200
Acid and zinc	4,000
Oils of various kinds	4,000
Improvements and necessary repairs	38,000
Copper and making up	2,000
Insurance	32,376
Hauling	12,540
Freight	5,000
Labels	32,400
Boxes	67,500
Taxes	11,400
Total cost of materials	$1,020,320

---

*A Scotch measure containing a little over a barrel, holding an average of about 750 herring.

Cost of labor.

Knitting nets, 228,000 fathoms	$128,250	
Catching salmon with cannery nets	400,000	
Catching salmon with private nets	300,000	
Salvage and hire of detectives	5,700	
White labor outside of fishing	93,956	
Other labor outside of fishing	142,000	
Total cost of labor		$1,069,906

Duty paid to the Government.

On 74,000 boxes tin plate, 7,992,000 pounds, at 1¼ cents	99,900	
On salmon twine	20,520	
Total paid for duty		120,420
Total of estimated payments		2,210,646

Including every detail of the work, it is a safe estimate to say that the Lower Columbia salmon canneries expend annually $2,500,000, the greatest part of which goes into circulation in the immediate vicinity. [From the Daily Astorian, Astoria, Oreg., January 13, 1887.]

NEW FISH-MARKET AND SALMON FISHING IN SCOTLAND.—Mr. John Anderson, writing from Denham Green, Edinburgh, on March 4, 1887, described a new fish-market. There were exhibited 150 salmon, averaging from 11 to 45 pounds each, with every kind of fine fish caught in Scotland or England. There was a salmon hatchery attached showing the salmon leaving the eggs. Also tanks with salmon two, three, and four years old, and with all kinds of trout of the same ages. The salmon fisheries extend over the Tay, Forth, Dee, and Tweed, besides numbers all along the coast. The rents are nearly $50,000; and already there are nearly 220 salmon fishermen on daily pay at rates ranging from $4.38 to $9.75 per week.

Very few small salmon have been seen this season as yet; but there has been a great crop of herling—supposed to be the young of the sea-trout—weighing from 6 to 12 ounces each, but pale. The floods have cleared our rivers of kelts and dead fish, so we may expect a good fishery in the autumn. The past winter here was mild, and our salmon fisheries all over have opened successfully.

CARP SOLD IN NEW YORK MARKETS.—Mr. John H. Brakeley, writing from Bordentown, N. J., on January 15, 1887, said:

"I have sold several hundred pounds of carp during the past autumn in the New York market, the commission merchant getting 15 cents a pound for them. I am satisfied that it will pay to feed carp, and shall do considerable of it next season."

SUCCESSFUL SHIPMENT OF CARP TO MEXICO.—Mr. Milton P. Peirce, writing from Philadelphia, Pa., on March 2, 1887, said:

"On February 12 I shipped 100 young carp—of the parti-scale variety, nearly scaleless—to the Government of Mexico. Yesterday a letter received from the Mexican secretary of the interior department announced that the tank of carp had arrived in the city of Mexico with a loss of only 5, the remaining 95 being in excellent condition. The fish were sent in one of my improved transportation tanks [simply the ordinary wash-boiler, or stove-boiler, with a piece of tin around the inside near the top, and with holes punched in the lid near each end], and traversed a distance of 3,700 miles."

SNAKES AT THE CARP PONDS.—May 3 and 4, 1887, Dr. Hessel killed with a rifle 250 snakes, which were believed to have come from the Potomac flats. So large numbers have never before appeared at one time.

CARP AND TENCH FROM POTOMAC RIVER.—Under date of March 16, 1887, Mr. J. E. Brown reported that on the same day Mr. J. F. Lucket had sent to Central Station the following specimens in good condition, which had been taken in the Potomac: One scale carp, weighing 4 pounds; mirror carp, over 7 pounds; leather carp, 7 pounds; and some tench, weighing over 1 pound apiece.

FISH-CULTURE IN ITALY.—Dr. D. Vinciguerra, late of the Museum of Natural History, at Genoa, has been appointed director of the aquarium at Rome. The aquarium contains a section for fish-culture, and is the center of this industry for Central Italy. The *Salmo salar* var. *sebago* is considered by him suitable for the clear, cold, and deep waters of the Latian lakes. He asks to have eggs of this species forwarded to him from the United States. [April 1, 1887.]

DELAWARE FISH COMMISSION.—Under date of May 3, 1887, Mr. Elwood R. Norny said that he had recently been appointed fish commissioner of Delaware, and that Dr. E. G. Shortlidge, of Wilmington, had been appointed assistant and superintendent of hatcheries. He proposed that the Fish Commission steamer Fish Hawk be sent to Port Penn this season to hatch sturgeon, which are taken there in abundance in seven nets. From June 5 to July 1 is the best season. Sturgeon have recently been hatched in Germany.

WHITE-BAIT.—This is a collective phrase including, for the most part, the young of the *Clupea harengus* or sea herring. It embraces the young of many other kinds, in one instance 14 species having been identified. The breeding grounds of sea herring in the United States extend from the Bay of Fundy to Block Island.

VESSELS FOR THE ICELAND HALIBUT FISHERY.—On March 25, 1887, the schooners Arthur D. Story and Annie M. Jordan sailed for Iceland. One more—the schooner Concord—is to start soon. [From Boston Fish Bureau, Boston, Mass., March 29, 1887.]

WHOLESOMENESS OF BORACIC ACID.—There are two sides to all questions. The British Medical Journal writes thus as to herring cured with boracic acid: Large quantities of herring, preserved with salt and boracic acid, being at present imported from Norway and sold in the London and Newcastle markets, and attempts having been made to prevent their sale, the National Sea Fisheries Protection Association discussed the question at a recent conference at Fishmongers' Hall, but no decision as to such fish was arrived at. It may, therefore, be worth while to point out that boracic acid, being the essential ingredient of our many food preservatives—be it in the form of the acid, of boroglyceride, or of borax—has been used for years, especially to preserve milk in hot weather, and no evidence has ever been brought forward even to suggest injurious effects upon the health; it may, therefore, be taken to be perfectly harmless. The Norwegian herring, preserved with salt and boracic acid, are of exceptionally fine quality, are perfectly fresh when brought into the market, and are, of course, subject to the usual process of inspection by the market inspectors, whose power of rejection is almost absolute. If, nevertheless, an outcry is heard against this sale, it is difficult to resist the belief that it is dictated by the jealousy which is notoriously rife in Billingsgate circles.

The introduction of cheap food from new sources, welcomed, as it always is by the public, is invariably opposed by the members of the trade, who, after all, reap the advantage in the long run. One has but to recall for a moment the sneers of meat venders at American and Australian meat to value the agitation against Norway herring at its proper worth. Hitherto, happily, we have been spared the bitter discussions which have on the Continent led to legislation against certain food preservatives, such as salicylic acid, which we in England admit without hesitation. The question is mainly one of national economy: Shall good food be wasted for want of a preservative, even if certain objections may be urged against its use, or shall we put up with these objections and aim at cheapening food for the masses, provided always that nothing which could injuriously affect their health is allowed to be present? A sufficient guarantee is afforded by the vigilance of medical officers, public analysts, and market inspectors against the abuse of antiseptics and food preservatives.

On the other hand, a fish-trader writes to the Fish Trades Gazette: Hundreds of barrels of herring from Norway out of one cargo were condemned, and also that there were about 1,500 barrels unsold lying in London at that time. France will not admit the Swedish and Norwegian herring, nor any other fish cured by the process named. Many shopkeepers soon find out to their cost that once their customers have tasted herring cured with acid they don't ask for them a second time. [From the Journal of the National Fish Culture Association, London, England, April, 1887.]

OREGON FISH COMMISSION LAW.—An act to provide for the propagation and preservation of salmon and food-fishes in the public waters of the State of Oregon, including so much of the streams which form common boundaries between said State and adjacent Territories, and appropriating money therefor. Also for the appointment of a fish commission.

Be it enacted by the legislative assembly of the State of Oregon, That there shall be chosen biennially by the legislative assembly of the State of Oregon three competent persons who shall be denominated the fish commission, whose term of office shall continue two years and until their successors be chosen and qualified.

SEC. 2. Before entering upon his duties each member of said commission shall file with the secretary of state a bond with ten or more sufficient sureties and in the sum of five thousand dollars, conditional that he will discharge his duties under this act faithfully.

SEC. 3. Said commissioners shall chose one of their number as chairman, and he shall be known as president of the fish commission.

SEC. 4. It shall be the duty of the president to give his entire time and attention to the fishing interests of the State of Oregon, and, by and with the advice and direction of the fish commissioners, see that all laws for the propagation, protection, and preservation of food-fishes in the public waters of the State of Oregon, whether entirely or partially within the State boundaries, are enforced; to select and purchase suitable land, build, operate, and manage thereon a fish hatchery, on the Columbia River or on its tributaries, for the purpose of supplying said waters with young fish; to employ necessary and competent men to successfully carry on the said hatchery on the Columbia River or on its tributaries; and to examine into and report upon the results of the salmon hatchery on Rogue River.

SEC. 5. That said fish commission shall annually, on December 1, report to the governor of this State a full account of its actions under this act; also of the operations and results of the laws pertaining to the fish industry, the methods of taking fish, the number of young fish hatched and where distributed, amount of expenses incurred, and make suggestions as to the needs of further legislation, if any, and full statistics of the fishing business.

SEC. 6. The president of the fish commission shall receive an annual salary of two thousand dollars; the other members of the commission shall receive five dollars each per day for time actually employed, not exceeding fifty days each per annum.

SEC. 7. That there be and is hereby appropriated out of the general fund of the State the sum of ten thousand dollars for the maintenance of the commission herein created and the erection and support of said hatchery on the Columbia River or tributaries for the period of two years; also there is hereby appropriated out of the funds of the State two thousand dollars for the purpose of enlargement and support of the present hatchery on the Rogue River during the year 1887.

SEC. 8. That all expenses incurred under the provisions of this bill shall be audited by the secretary of state, upon bills being presented properly certified by the president as approved by the commission, and the said secretary shall from time to time draw warrants upon the State treasurer for the amount.

SEC. 9. The fish industry urging immediate action in these respects, this act shall take effect from and after its approval by the governor.

Passed by the senate February 16, 1887; J. C. Carson, president of the senate. Passed by the house February 18, 1887; J. T. Gregg, speaker of the house.

The names of the commissioners appointed under the above law are F. C. Reed, of Astoria; R. C. Campbell, of Rainier; and E. H. Thompson, of Rogue River.

An appropriation of $10,000 was made for a salmon-hatching station on the Columbia or tributaries, and one of $2,000 for the one on Rogue River.

There was also appointed by joint resolution a committee of two on the part of the senate and three on the part of the house, to examine the different modes of taking fish in the waters of the Columbia River, and report by bill or otherwise to the next legislature any law or restrictions that in their opinion may be necessary for the protection of salmon and other food-fishes in the waters of said river.

The committee decided to make a tour of the Columbia River during the month of June, 1887, when all the different modes of taking fish are in operation, in order to determine which, if any, need restriction.

AN ACT TO GRANT CERTAIN SEAL ROCKS TO THE CITY AND COUNTY OF SAN FRANCISCO, STATE OF CALIFORNIA, IN TRUST FOR THE PEOPLE OF THE UNITED STATES.*—*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That all the right and title of the United States in and to the rocky islets known as the Seal Rocks, and all rights to seals resorting there, situated off Point Lobos, in the city and county of San Francisco, State of California, are hereby granted, subject to the provisions named, in trust to said city and county, upon the following conditions and for the following uses, to wit: Said city and county shall hold said Seal Rocks inalienable for all time, in trust for the people of the United States, and shall commit to the commissioners of Golden Gate Park the custody and care of said Seal Rocks, and shall keep said rocks free from encroachment by man, and shall preserve from molestation the seals and other animals now accustomed to resort there, to the end that said Seal Rocks will continue to be a public preserve and resort for seals: *Provided,* That the United States may at all times control and limit or diminish the number of the seals resorting to said rocks so as to protect the fisheries and fishing industries: *And provided further,* That whenever any of said rocks, or the space occupied by said rocks, shall be required by the United States for the erection or maintenance of any public work, or for any other purpose, then as to the rocks or space so required the provisions of this act shall terminate, and the United States shall be reinvested with the full title, control, and possession thereof. Said city and county shall signify its acceptance of this trust, and thereupon the Commissioner of the General Land Office shall file in his office a plat showing the locus of said Seal Rocks, and said plat shall be the evidence of the extent and position of the premises hereby granted.

---

* This act (S. 2428) passed the Senate June 17, 1886, and passed the House of Representatives February 8, 1887. It was approved by the President February 23, 1887, and thus became a law.

SEC. 2. That all acts in conflict with the provisions of this act are hereby declared inapplicable to the premises hereby granted.

LIVE CARS.—In reply to the inquiry of Messrs. Broughton & Freitas, of Portugal, Mr. A. Howard Clark, who had charge of such matters at the London Exhibition, states, under date of May 27, 1887, that the tow-cars employed by the fishermen in transporting the catch from the fishing grounds to port are usually in the shape of flat-bottomed, decked boats, sharp at both ends, with a hinged opening on top for inserting the fish. The sides are pierced with auger holes, to give free circulation of water. A common size of tow-car is 5 feet long on top, 3 feet long on bottom, 2 feet wide on top amidships, about 1½ feet wide on bottom, and about 14 inches deep amidships, with considerable sheer fore and aft. The marketmen's cars, moored at the fish wharves, are generally of rectangular shape, about 12 feet long, 8 feet wide, and 3 feet deep. They are made of 1-inch plank, 6 inches in width, which is nailed to a rectangular frame of joist. Spaces of 1½ to 2 inches are left between the planks. They are either with or without compartments, and are opened on top by hinged doors. At some ports these cars are made 25 feet long, 16 feet wide, and 5 feet deep, and divided into 6 compartments. Empty casks are sometimes used to buoy them. In the lobster fishery, fishermen often use leaky boats, provided with decks, in which to keep their lobsters alive.

CARP, SHAD, AND STRIPED BASS IN CALIFORNIA.—Mr. Charles Kaeding, writing from San Francisco on May 18, 1887, stated that carp are being taken in great abundance, some weighing 15 pounds. The shad are also becoming very plentiful; while striped bass have been caught this year weighing as much as 25 pounds, and appear to be doing well on this coast.

SHAD IN THE OHIO RIVER.—Mr. W. M. Birely, writing from Vanceburgh, Ky., on May 16, 1887, stated that in the spring of 1885 he bought from a net-fisherman on the Ohio River two genuine Potomac shad, one weighing 3 pounds and the other 4 pounds. He added that in the Ohio they have what is known as "hickory shad," a fish specifically different from the shad above mentioned.

WHITEFISH IN IRRIGATING DITCHES.—The irrigating ditches for the past two days have been filled with lake whitefish, and the small boy has had a good deal of sport ladling them out in tin buckets. Fish Commissioner Otto Gramm and Dr. H. J. Maynard planted altogether 150,000 whitefish in Sloan's Lake. Water is being drawn from there through pipes for irrigating purposes, and as no netting prevents their escape, the fish passed through into the ditches in great numbers. The fish planted last January are already 3 inches long. [From the Cheyenne (Wyo.) Sun, May 25, 1886.]

Vol. VII, No. 4. Washington, D. C. June 6, 1887.

13.—FISH-CULTURE ON THE PACIFIC COAST.

By HORACE D. DUNN.

[From a letter to Prof. S. F. Baird.]

The *Salmo irideus*, or red-banded trout of the McCloud River of California, having been introduced into Atlantic waters, it may interest you to learn how this variety of fish has thrived when introduced into the coast range streams of this State which empty directly into the Pacific Ocean.

On the 12th day of April, 1887, John L. Durkee, while fishing in a small stream which empties into the Pacific Ocean in Marin County, about 7 miles from Saucelito, caught a red-banded trout (*Salmo irideus*) that weighed about 14 pounds. The fish was a female, and had come into the stream to spawn, it being in a gravid condition, so that about a quart of eggs (estimated) flowed from it while being taken from the water. When taken to Saucelito, about five hours later, the fish weighed just 12¾ pounds.

This trout was undoubtedly one of a lot planted by the late Mr. S. R. Throckmorton, then fish commissioner of this State, in the stream where it was caught on property belonging then to that gentleman. The marking was a brilliant cochineal color on the gill-cover, say 2½ inches in diameter, and a well-defined stripe or band of the same color 2 inches wide extending from the gill-opening down the median line to and including the tail. So far as I know, the largest specimen of this variety of trout taken in the native stream (McCloud River) has weighed 6 pounds, the fish never migrating from that place to the ocean, a distance of somewhere about 400 miles. This species of trout, under the direction of the late commissioners, Messrs. Redding and Throckmorton, were placed in many of the streams of Sonoma, Marin, San Mateo, and Santa Cruz Counties which empty directly into the Pacific. From these short streams, ranging from 30 to 150 miles long, the fish have ample opportunities to migrate to the ocean, and do so, having been taken in brackish water at the mouths of the streams on various occasions. They seem not only to thrive faster (from abundance of food, no doubt), but take on an outer coating of color (like marking of lead), which they afterwards lose after being in fresh water some time. I think these fish would do well in the short streams along the Atlantic shore between Virginia and Maine.

Some years since the then fish commissioners, B. B. Redding and S. R. Throckmorton, introduced two lots of young striped bass or rockfish into San Francisco Bay. The first lot were small fish, say 2 to 3 inches long, and were placed in Suisun Bay, near Martinez, by Mr. Redding in person. These fish thrived and passed the nets of the Chinese and got to sea and returned, one being taken two years later weighing 4 pounds. Another lot was brought from the Atlántic coast in August of the year that Mr. Redding died, and were put into the bay at Arsenal Point, about 3 miles distant from the preceding one. The fish have apparently done well, specimens having been taken in nets at intervals of a few days all through the past two summers. The largest of these weighed 23 pounds. Lately striped bass have been taken almost daily in the waters of the bay near this city, and fish dealers in the markets claim that within the next four years this variety of fish will be as plentiful as shad are now. I am informed that striped bass have been taken at places as widely separated as from San Diego to the Oregon line.

I would suggest sending two tanks of blackfish (tautog, I think), which are common to the Long Island Sound and Southern Massachusetts coast. The late Mr. Throckmorton informed me that some of this kind of fish were sent probably ten years ago, that they arrived alive, and that he put them at once into the waters of San Antonio Creek, near Oakland. These fish have never been heard from, and I think that as they were weak from the journey overland and were placed in muddy water at least 2 miles from any rocky shelter or supplies of food, they fell victims to their enemies, such as dogfish, sharks, and stingrays, through which they had to pass out into the bay. I think it is poor policy to bring adult fish thousands of miles and then place them tired and weak where their enemies are alert and strong. If any blackfish are sent they should be rested and fed in fish-cars for at least a week or ten days until they become strong again and are able to take care of themselves.

The black bass which were brought to California some years since have done well. Those of the State fish commission were placed in the Crystal Spring Reservoir, which in part supplies water to this city. The bass did well, and about four years since some were taken and placed in Russian River, Sonoma County, near Guerneville. These seem to have done well, and spread both up and down the stream, which is fully 100 miles long. Yesterday a bass taken in Russian River, near its entrance into the Pacific, was on exhibition in one of our markets. It was taken in a net and weighed 5 pounds. If they would not destroy the young shad and salmon, the Sacramento would be an admirable stream to place bass in between the junction of Feather River and Red Bluff.

SAN FRANCISCO, CAL., *April* 27, 1887.

14.—SEA FISHERIES OF FRANCE AND ALGERIA IN 1885.*

[Abstracted from the report to the minister of marine and the colonies.]

FRANCE.

General statements.—During the year 1885 there were engaged in the fisheries 23,877 vessels or boats, with a capacity of 160,299 tons, and manned by 85,915 registered sailors. To these should be added 338 Italian fishing boats, carrying 764 tons and manned by 1,094 men, which were engaged in fishing on the coast of the fifth maritime district (Toulon). Also 57,088 persons (men, women, and children) engaged in fishing on foot from the shore. These figures, as compared with those for 1884, show a decrease of 60 vessels, 2,225 tons, and 1,268 men.

On the other hand, the value in silver of the products of the fisheries amounted to 92,736,585 francs† [$17,898,161], showing an increase of 4,775,461 francs [$921,664] over that of 1884, as is shown in Table I. This increase is particularly noticeable in the cod and sardine fisheries, while there was a considerable falling off in the herring fishery and the fisheries for those kinds designated as "other fish."

The products of the cod fisheries at Newfoundland and Iceland, and of the herring, mackerel, and anchovy fisheries, as well as of all those designated as "other fish," amounted in 1885 to 187,853,359 kilograms [414,141,515 pounds], against 149,661,099 kilograms [329,942,859 pounds] in 1884, showing an increase in 1885 of 38,192,260 kilograms [84,198,656 pounds]. There was also an increase in 1885 of 82,258,815 sardines, 7,302,022 oysters, 52,366 hectoliters [148,196 bushels] of mussels, 69,218 hectoliters [195,887 bushels] of other shell-fish, and 205,381 kilograms [452,783 pounds] of shrimps; while there was a decrease of 131,816 crustaceans (lobsters, &c.).

On December 31, 1885, there were along the coast 48,621 fishery establishments, occupying an area of more than 13,879 hectares [34,295 acres], and employing 49,068 persons.

Cod fisheries.—The fishing schooners fitted out in the French colony of St. Pierre and Miquelon, the number of which in 1885 was 182, worked especially on Banquereau, where cod were found in great abundance; while the vessels sent from France to fish on the Newfoundland banks also made a good catch.

---

* "*Statistique des pêches maritimes et de l'ostréiculture pour l'année* 1885." Paris, 1887. Translated from the French by H. P. JERRELL. For a corresponding article for 1884, see F. C. Bulletin for 1886, pages 219 and 305.

† Throughout this article reductions have been made according to the following equivalents: 1 franc = 19.3 cents; 1 kilogram = 2.2046 pounds; 1 hectoliter = 2.83 United States bushels; 1 cubic meter = 35.31 cubic feet; and 1 hectare = 2.471 acres.

The first vessels for the season from France for the Iceland cod fishery left during the latter part of February, but the most of the fleet did not leave till the first part of March. The results of the fishery on the east and west coasts of Iceland show a marked difference.

Vessels on the west coast began operations near Torlak with fair results. In May and June cod of good size were found very abundant at Sneefield and Brede Bay. In the following months the fishermen sailed back from Patrikfiord to Isafiord, where they still obtained good results. Fares of from 55,000 to 60,000 were not uncommon, and some even took as many as 65,000 codfish.

Vessels on the east coast fished to the southeastward, from Ingolf to Walsback, during the first part of the season, with but slight success. By the end of May the smallest capture of a vessel on this coast was about 9,000, and the largest was about 25,000, which numbers were fairly satisfactory for this time in the year. Towards the middle of June the vessels were scattered from Ingolf to Langanæs, but everywhere the fishery yielded slight results, nor did it improve in July. Fishing on the east coast, then, where the cod are generally large and of fine quality, was not so favorable as usual; and several vessels, after the first part of the season, left for the west coast where they completed their fares.

Of the total product of the cod fisheries in 1885, Newfoundland furnished 26,871,000 kilograms [59,239,806 pounds], valued at 9,068,903 francs [$1,750,298], and Iceland furnished 12,913,352 kilograms [28,468,776 pounds], valued at 7,331,910 francs [$1,415,059], both showing a considerable increase in quantity and value over the product of 1884. Two vessels were lost during the fishing season, the Travailleur and the Lorraine, both of Dunkirk; but the crews were saved.

Herring fishery.—The number of boats fitted out in 1885 for this fishery was 142, being 10 less than in 1884. About the end of June most of the boats from Boulogne left that port for the North Sea; while those from St.-Valery-en-Caux and some from Fécamp joined them in July. Up to the end of that month they had met few herring, and had generally fished for cod; but during the first days of August large shoals of herring appeared from 60 to 80 miles off the coast, between Peterhead and Aberdeen. In a few tides the vessels made full catches, carried them to France, and returned about August 20 off the Scotch coasts, where the fishery continued successfully till the last of September, especially off Montrose and St. Abb's Head. Off Yarmouth the herring were equally abundant, but after October 10 bad weather baffled the fleet and drove it back to the French ports in a few days. Soon after this the fishery for fresh herring began, and ended in March, 1886, having given good results.

On the whole, the fish were taken in large enough quantities; but the few markets the fishermen have for disposing of their catch, the high rates of the railway companies, and the impossibility of forwarding the fish by all the trains, are the principal causes which annually keep down to a low figure the net returns of this fishery.

Sardine fishery.—Although yielding results greater than those of 1884, the amount of sardines caught in 1885 was not large. These fish for many years have come on the French coast late and at rare intervals, seeming to stop generally off the coasts of Portugal and Spain, where they are caught in great abundance. In 1885, sardines of good size appeared on the French coast from the middle of June to that of July, when they left, to come on again in small quantities in September. The fishermen of Douarnenez and Audierne are about the only ones who have realized any profits from this fishery, though the scarcity of sardines resulted in a rise in price, which has kept up all the season.

Fisheries for fresh fish.—These fisheries (comprising those for turbots, dabs, soles, flounders, rays, gurnards, mullets, whiting, salmon, sturgeon, tunnies, congers, lampreys, &c.) were satisfactory in the amounts taken, but the value of the products suffered a slight depreciation, which is due in part to the sale of tunnies, the price of which fell considerably in consequence of the reappearance of the epidemic of cholera, rendering the disposal of the catch of tunnies somewhat difficult. Steam craft always obtained good results, as did also decked vessels of sufficient size to leave port at almost any time, while the smaller boats remained inactive in harbors during part of the winter.

Oyster fishery.—During the year 126,579,817 oysters (native and Portuguese), the yield of the coast and boat fishing, sold for 1,674,826 francs [$323,242]. These figures, as compared with those for 1884, show a gain of 7,302,022 oysters in number, and a loss of 70,109 francs [$13,530] in value.

During 1885, a total of 597,164,013 oysters, born or raised in parks, tanks, ponds, and other oyster-cultural establishments on the coast, have been sold for public consumption, bringing 12,744,716 francs [$2,459,730]; while in 1884, 529,768,767 oysters were sold for 13,577,926 francs [$2,620,540]. This shows that the production was greater in 1885, but that it was not accompanied by a corresponding increase in value. This state of things should be attributed to the excess of the Portuguese oysters (*Ostrea angulata*), which were sold at 10 francs [$1.93] per 1,000, and to the decrease in price of the native oysters (*Ostrea edulis*), which decrease amounted to from 6 to 13 francs a thousand according to locality.

Marine fertilizers, &c.—The marine plants, commonly called sea-weeds or *Algæ*, are put in three classes:

1. Sea-weed growing near the shore.
2. Sea-weed cast up on the beach—wrack.
3. Sea-weed growing in the sea.

Sea-weeds of the second class, whose collection is permitted all the year, comprise the bulk of what is taken. All three classes are generally employed in fertilizing the land and making chemical products. Moreover, there is a kind of sea-weed, common in the bay of Granville and called *zostera* or *pailleule* which is eagerly sought for making different kinds of bedding, and sells at the rate of 150 to 170 francs per cubic meter [82 to 93 cents per cubic foot]. The value of the total amounts of sea-weed collected in 1885 was 5,495,052 francs [$1,060,545], which was 302,453 francs [$58,374] less than in 1884.

ALGERIA.

General.—During 1885 there were engaged in the fisheries on the Algerian coast 1,047 boats, with a total capacity of 3,999 tons, manned by 4,495 men. These figures, as compared with those of 1884, show for 1885 a decrease of 13 boats, with an increase of 411 tons and 31 men. Fishing from the shore is but little practiced in Algeria.

The value in silver of the products obtained reached the sum of 4,101,380 francs [$791,566], and shows an increase of 343,990 francs [$66,390] over that of 1884, which increase arises largely from greater returns from the coral fishery and from those indicated by "other fish."

The products of the fisheries for mackerel, bonitos, tunnies, anchovies, and the different kinds designated as "other fish," amounted in 1885 to 4,216,512 kilograms [9,295,723 pounds], against 4,039,985 kilograms [8,906,551 pounds] in 1884, showing an increase in 1885 of 176,527 kilograms [389,172 pounds]. There was also an increase in 1885 of 28,292,394 *allaches*, 4,372 kilograms [9,639 pounds] of shrimps, and 254 hectoliters [718 bushels] of other shell-fish; while there was a decrease of 10,942,111 sardines, 36,120 oysters, 14 hectoliters [40 bushels] of mussels, and 6,205 crustaceans (lobsters, &c.). More complete details are to be found in Table II appended.

Coral fishery.—The coral beds which formerly existed in great numbers on the coast of Algeria, especially in the waters of the old district of Calle, were worked almost exclusively by Italian fishermen, who carry off to their own country, at the end of the season, the produce of their work. These beds were protected only by the prohibition of fishing implements recognized as injurious; but even this prohibition has remained a dead letter, as the means of surveillance at the disposal of the authorities were always insufficient. This state of things would soon result in the destruction of the coral beds, and it was to remedy this that the decree of November 22, 1883, was interposed to regulate the coral fishery in Algeria and Tunis.

Loss of life.—During 1885, 363 enrolled sailors on boats engaged in the fisheries on the coasts of France and Algeria have been drowned or lost at sea, leaving 212 widows and 416 orphans; while during the previous year 413 fishermen were lost.

The following tables give a recapitulation for two years of the sea fisheries of France proper and of the French colony of Algeria:

TABLE I.—*Quantity and value of the sea fisheries of France in* 1884 *and* 1885.

Kind.	1884.		1885.		Value in 1885 compared with 1884.	
	Quantity.	Value.	Quantity.	Value.	Increase.	Decrease.
Cod.................pounds..	80,510,764	$2,643,332	87,708,582	$3,165,357	$522,025	....
Herring ....do....	101,352,473	1,720,844	99,062,136	1,667,987	....	$52,857
Mackerel..............do....	21,162,427	712,487	19,077,420	732,139	19,652	....
Sardines ....number..	411,819,005	1,702,949	494,077,820	2,205,463	502,514	....
Anchovies.........pounds..	11,460,503	201,354	87,548,994	211,185	9,831	....
Other fish ....do....	115,456,692	7,043,843	120,744,383	6,918,663	....	125,180
Oysters ....number..	119,277,795	336,772	126,579,817	323,242	....	13,530
Mussels ....bushels..	1,361,966	356,549	1,510,162	460,646	104,097	....
Other shell-fish ....do ..	1,040,529	246,184	1,236,416	258,674	12,490	....
Lobsters, &c.......number..	1,927,229	528,184	1,795,413	488,846	....	39,338
Shrimps ....pounds..	3,466,623	365,080	3,919,406	405,414	40,334	....
Marine fertilizers..cu. feet..	88,174,261	1,118,919	84,378,047	1,060,545	....	58,374
Total	....	16,976,497	....	17,898,161	921,664	....

TABLE II.—*Quantity and value of the sea fisheries of Algeria in* 1884 *and* 1885.

Kind.	1884.		1885.		Value in 1885 compared with 1884.	
	Quantity.	Value.	Quantity.	Value.	Increase.	Decrease.
Mackerel...........pounds..	847,148	$67,754	324,848	$15,735	....	$52,019
Sardines..............number..	110,138,331	134,508	99,196,220	108,860	....	25,648
Anchovies..........pounds..	688,031	34,455	1,225,240	70,229	$35,774	....
Other fish ....do	7,027,057	357,128	7,307,515	387,272	30,144	....
Lobsters, &c.......number..	34,510	12,890	28,305	11,143	....	1,747
Allaches...............do	30,639,640	43,874	58,932,034	52,981	9,107	....
Other shell-fish....bushels..	207	383	925	2,817	2,434	....
Shrimps ....pounds..	95,968	8,276	105,607	9,616	1,340	....
Bonitos................do....	232,136	14,924	144,245	7,959	....	6,965
Tunnies ....do....	112,179	7,303	293,875	25,394	18,091	....
Coral...................do....	11,823	42,437	25,102	98,949	56,512	....
Mussels ....bushels..	125	505	85	107	....	398
Oysters ....number..	238,020	739	201,900	504	....	235
Total	....	725,176	....	791,566	66,390	....

PARIS, FRANCE, *January* 25, 1887.

15.—RAINBOW TROUT IN SOUTHWESTERN MISSOURI.

By Dr. R. J. MAYNARD.

Very great success has been gained in stocking Spring River, and this indicates what can be done in all the waters of Southwestern Missouri, from and including the Osage River on the north and the Gasconade River on the east.

October 9, 1885, I went to the head of Spring River with Dr. E. P. Hansard, of Pierce City, Lawrence County, Missouri, to classify a trout said to be found there. On beginning fishing he immediately landed a 17-inch fish that proved to be a rainbow trout, sometimes known as the California red-sided trout. Soon afterwards another of the same species was taken, weighing a little over 4½ pounds when dressed. In a study of the stream for about a mile I saw over 100 trout, ranging from 12 to 18 inches in length, and about 30 of the larger size were taken. At the head of the river, which is an immense spring, and within 100 yards below, I saw many thousands of the last hatching, which were 4 or 5 inches long.

Thirty or forty were caught during this last summer a mile or so below the head of the river, where the water gets as warm in summer as it does in any of these streams, which shows that these fish will thrive all over this section of Missouri. These trout are the remnants and progeny of 1,500 fry planted June 10, 1882, and their growth is extraordinary. Even if they had been planted one or two years before, the growth is surprising, and shows that with a little care and expense all these streams can be made alive with a remarkably fine game fish, which is also an excellent and delicate table fish.

It is, moreover, more hardy than is generally supposed. I have planted it in the shallow creeks of the Wyoming plains, where the water gets so warm and is always so alkaline that scarcely anything but the hardy cyprinoids can live, and the rainbow trout has done well in them.

CHEYENNE, WYO., *March* 29, 1887.

16.—SALMON NOT INJURED BY CATFISH.

By HORACE D. DUNN.

Word has gone out that catfish have been taken in Suisun Bay whose stomachs were full of young fish and salmon spawn. Upon this statement a cry has been made that the catfish were destroying both spawn and young salmon. The facts of the case are that the catfish were caught in the vicinity of a salmon cannery, and that the spawn was among the fish-offal thrown into the bay; and the young fish were "split-tails" and not valuable for food purposes. No salmon cast their spawn naturally within 250 miles of where the catfish were taken, and no young salmon are to be found in that vicinity but of such size and vigor that the catfish could neither catch nor swallow them. All the smolts or parr caught in the waters of San Francisco Bay, so far as I have known, have been over six inches long, and if they could escape the "hard-mouths," or pike and sturgeon, in passing down a river for 250 miles, a sluggish catfish would not be apt to catch them.

SAN FRANCISCO, CAL., *June* 8, 1887.

17.—CAUSES OF THE DECREASE OF SALMON IN THE SACRAMENTO RIVER.

By JOSEPH D. REDDING.

The failure in the salmon catch of the Sacramento River during the last four years arises from several causes. First of all, the river has for years been filling up with débris coming down from the hydraulic mining. This has choked up many of the little streams up which salmon formerly went for the purpose of spawning, and has also fouled the river generally. The Sacramento River is a filthy stream. One effect of the débris also has been to cause the Sacramento to overflow its banks and spread over the surrounding plains, thereby causing a heavy growth of tules. The water recedes very quickly, and I have myself seen acres of young fish left high and dry entangled in these weeds. Farmers use the fish thus stranded for manuring purposes.

The second cause is the general violation of the fish law by the Italian and Greek fishermen, and the failure properly to prosecute them under this law. These fishermen catch everything, young and old, and sell the young to the Chinese who ship them to China. It requires a police patrol up and down the river constantly to prevent these marauders from capturing every fish that comes into the harbor. I am glad to say, however, that the strenuous efforts of the State fish commission have succeeded in gaining the respect of these fishermen at last, and they are gradually beginning to obey the law.

A third cause is the presence of great numbers of seals and sea-lions at the mouth of Golden Gate harbor. There are probably 3,000 seals and sea-lions swarming around Golden Gate, each eating from 20 to 40 pounds of fish daily, and mangling a great many. I think they should be exterminated, but many consider that these sea-lions are one of the attractions of the Pacific coast, like the Yosemite and the Geysers; and every suggestion or effort that is made to have them killed off is met by a storm of opposition. Finally the U. S. Fish Commission did a great deal towards stocking the headwaters of the Sacramento with young salmon, and the State commission in past years has done likewise; but within the last five years there has been hardly any deposit of young spawn in the headwaters of these streams.

I do not think that catfish have materially affected the salmon catch in the Sacramento. The salmon spawn at the head of McCloud, Pitt, and Sacramento Rivers, in very shallow water; while catfish prefer sluggish water with a mud bottom. No catfish have been heard of farther up the Sacramento than Tehama, which is at least 60 miles below any of the spawning grounds. Some salmon spawn was found in the stomach of a catfish at one of the salmon canneries on the river a short time ago, and a great hue and cry was raised. The fact is that the spawn was thrown into the water from the salmon caught by fishermen and sold to the canneries. As to catfish, I believe their importation to this coast was an error; and the board of fish commissioners who authorized their importation, if I remember rightly, came to the same conclusion. The fish which they destroy, however, are perch and dace and their spawn, which at one time were found in vast numbers in the Sacramento.

SAN FRANCISCO, CAL., *June* 8, 1887.

18.—THE EGGS OF FISHES.*

By Prof. McINTOSH, LL. D., F. R. S.

[Abstract of an introductory lecture delivered to the class of natural history in the University of St. Andrew's.]

It is but a short time since works devoted to the history of British fishes were devoid of allusion to any other mode of spawning than that by which the eggs of our marine fishes are deposited on the bottom of the sea. Indeed it was believed by most naturalists that the latter was the normal mode of deposition. As a consequence, some of the text-books at present in use either follow the latter view, or do not specially allude to the question.

The eggs of all fishes are produced in the ovaries, which are symmetrical organs lying beneath the vertebral column, and which at different periods of the year present various appearances according to the degree of development of the eggs. Thus in the quiescent condition of the organs their size is insignificant, while the fully developed ovaries of the codfish occupy a large space and weigh several pounds. At first the eggs are very small, but they gradually increase in size by imbibing nourishment from the ovarian follicles in which they are placed.

A feature not sufficiently insisted on in Great Britain is the fact that only a portion of the ovary in most marine fishes becomes "ripe" at a given time. This provision appears to be admirably suited for the increase of the fishes, a constant succession of the embryos being thus liberated, and time afforded for those of one stage to disappear from the surface of the ocean before those of the succeeding take their places. In America this condition has been clearly described in the report on the cod fisheries of Cape Ann,* by Mr. R. E. Earll; but the account does not seem to have come under the notice of Mr. William Oldham Chambers, who alluded to the subject a year or two afterwards.†

Mr. Earll observes that "the individuals [that is, the cod] do not deposit all their eggs in a single day or week, but probably continue the operation of spawning over fully two months." The result of this arrangement is that some of the American codfish begin to spawn in September, and some continue as late as June. The cod in our seas do not follow the same habit, though their spawning period extends on each side of the beginning of April. In the same way the period during which the eggs of the various kinds of skates are deposited is considerably lengthened.

---

* See U. S. Fish Commission Report for 1878, pp. 685, 714, *et seq.*

† "Fish and Fisheries," prize essays, International Fisheries Exhibition, Edinburgh, 1883, p. 187.

On the other hand, such marine fishes as the lumpsucker (*Cyclopterus lumpus ?*) and bimaculated sucker, the salmon, trout, and most fresh-water fishes seem to deposit their eggs within the limited period of a day or two, and consequently the development of the masses of eggs in the ovaries is more nearly simultaneous.

In general form the eggs of ordinary fishes are circular. On deposition they are usually invested by a single layer (*zona radiata*), though in some, as in the herring, there is another, namely, the vitelline membrane, which lies outside the former. The great mass of the egg is formed by the oval spherules of the food-yelk, which are separated by protoplasmic bands. Near one of the poles the protoplasm usually forms a lenticular area, the germinal disk or germinal area, and the smaller yelk-spherules in this region differ in character from those of the general mass of the egg. During development the eggs show partial segmentation, the process being chiefly confined to the germinal area.

While the circular form as just described is characteristic of the eggs of most fishes, we have a few marine types which deviate from the general rule, such as the glutinous hag (*Myxine glutinosa*), with its ovoid and fringed eggs; the goby, with its fusiform ova; the gar pike, saury pike, and flying-fish, which have long filaments attached to their eggs, probably for the purpose of fixing them to floating structures of any kind. Among other interesting types are the large eggs of the stickleback and the salmon tribe, and the almost microscopic eggs of the eel. The large ova of the salmon and trout are surpassed, however, by those of the siluroid genus *Arius*, found both in the Old World and the New (Ceylon and Guiana), the eggs being somewhat larger than a pea (5 to 10^{mm}.); but this is not the only remarkable feature in these fishes; for as Drs. Günther and Wyman and Professor Turner have shown, the large eggs are carried by the male in his mouth and gill-chamber until hatched, the small and almost granular palatine teeth making this possible without injury to the ova. He thus acts the part of a "dry-nurse," as also does the male pipe-fish (*Syngnathus*) and the sea-horse (*Hippocampus*), the eggs being borne by the male in a pouch on the under surface. In another siluroid fish (*Aspredo*) from Guiana, the remarkable exception occurs of a female fish interesting itself in the care of its young. The skin on the under surface becomes soft and spongy, and the eggs, which are deposited on the ground, adhere by simple pressure of the body over them, very much after the arrangement in the

Surinam toad. Only one other female fish shares with this one the distinction just noted, namely *Solenostoma*, an Indian lophobranch, in which the ventral fins, which are free in the male, coalesce to form with the integuments a pouch for the reception and hatching of the eggs. The entire group of the sharks and rays (*Elasmobranchii*), again, is characterized by the peculiar condition of their eggs, which are distinguished not only by their great size, but also by the fact that they are either deposited in horny capsules, or retained in the oviduct until hatched. The former takes place in the common rays, certain dogfishes (*Scyllium*), and sharks (*Cestracion*), and in the curious *Chimæra* and *Callorhynchus;* while the latter (that is, the production of living young) occurs in the rest of the sharks and in the torpedoes.

As already indicated, the prevalent notion among the older naturalists was that fishes of all kinds deposited their eggs on the bottom of the sea, and that extensive migrations were made for this purpose, the general impression being that the majority proceeded shorewards to deposit their eggs in the shallow water. This impression was probably due to the fact that the salmon, and perhaps the herring, followed this habit, the former proceeding up rivers and the latter selecting certain banks, often near land, covered with sea-weeds and zoophytes, or a bottom composed of stones and gravel; and it was assumed by the older observers that all marine fishes followed similar habits. Thus it was supposed that the cod, haddock, whiting, ling, hake, and other fishes frequented certain banks for the purpose of depositing their eggs, and that various flat-fishes, such as the larger turbots and soles, came from deep water to shallow water for the same end. Such conjectures, however, were found to deviate very considerably from the facts.

Among the earliest to notice that the eggs of certain marine fishes floated were the cod fishermen of the Lofoden Islands, off the coast of Norway. These Norwegians had noticed that what they called the "roe" of the codfish floated in the water on the great fishing-banks, and often at certain seasons to such an extent as to make the water thick. Prof. G. O. Sars, inspector of fisheries in Norway, to whom this remark was made, supposed that the fishermen had mistaken some of the lower marine animals for the eggs of fishes; for such a feature was in direct opposition to anything he knew of the spawning of fishes. The subject, however, was soon set at rest, for he proceeded in 1864 to the fishing-grounds off the Lofoden Islands, and captured in the townet immense numbers of the eggs of the cod floating at the surface of the sea. Next year, indeed, on a calm day, Professor Sars found the sea covered with a dense layer of floating spawn, so that with a sufficiently large net, he could have taken tons of it. This occurred over a celebrated fishing-ground, on which the cod were present in enormous numbers, so as to form what the fishermen called a "fish mountain." Professor Sars also found that the ova of the haddock floated, and among the eggs procured from the surface of the sea were some from which young fish resembling gurnards emerged, and he correctly concluded that the ova of the gurnard followed the same habit as those of the cod and haddock.

The impetus given to such observations by the energetic action of the United States Fish Commission enabled the Americans to corroborate the discovery of the Norwegians in regard to the floating of the ova of the cod, which lately have been artificially hatched on a somewhat extensive scale on their coasts. The labors of Prof. Alex. Agassiz in the same country have further added to our knowledge of floating eggs, showing that the number of fishes in which this occurs is considerable. Thus the majority of the American flounders, certain kinds of wrasses (*Ctenolabrus*), a species of smelt (*Osmerus*), several species of *Cottus*, the cod, haddock, gurnard, shad, mackerel, and Spanish mackerel, a kind of dory (*Zeus*), and the frog-fish are among those which have floating eggs. The late Dr. Malm, of Gothenburg, further increased the list by discovering that the eggs of the plaice were similarly buoyant; and G. Brook has recently added to this category the eggs of the lesser weever. The very great influence which this floating of the tiny eggs exercises on the multiplication of the food-fishes will be apparent as the subject is further examined.

On the other hand, most fresh-water fishes (except the shad) deposit their eggs on the bottom, like the salmon, or on water plants, like the carp and pike; while other marine species, such as the herring, sprat, lumpsucker, and bimaculated sucker, follow a similar method. The number of marine fishes which are supposed to deposit their eggs on the sea-bed is yearly diminishing, while the ranks of those in which the ripe eggs are found to float correspondingly increase.

To come now to our own shores, and to confine our remarks to what is really the most important group of fishes, namely, the food-fishes, we find that early in spring the surface of the sea over the great fishing-banks (such as Smith Bank, off the northeast of Scotland, off Caithness), presents vast numbers of floating eggs of food-fishes, together with multitudes of the very young fishes provided with a yelk-sac, exhibiting various degrees of absorption. Some of the ova (as those of the haddock and gurnard) are larger than those of the cod, but they are few in number; while those of a fourth kind are smaller than any yet mentioned. When placed in a vessel of sea-water the eggs persistently float on its surface, descending but a very little when the jar is rudely shaken. Even after a protracted journey only the dead eggs roll on the bottom of the vessel, while all the floating eggs are living. Moreover, the eggs were removed from the cod itself and carried from Smith Bank to the marine laboratory at the harbor. On arrival, these floated at the surface of the vessel. On transfering them to a large jar and turning on a tap of sea-water a great change occurred. The ova in a few minutes lay on the bottom. Microscopic examination subsequently showed that the edge of the germinal area was disintegrating, free protoplasmic processes and separate cells occurring all round. The cause of this sudden change was doubtless the impurity of the water (for the proper apparatus had not yet been fitted up), the metallic pipe (block-tin) containing an opaque whitish deposit which speedily killed the ova. The addition of methylated spirit in the same way sends all the eggs and embryos to the bottom. Professor Sars, indeed, mentions that if the eggs of the cod are placed in fresh water they sink and never rise again, but are killed—just as a newly-hatched salmon is killed, though somewhat more slowly, by immersion in sea-water. He thinks that even a fall of rain might affect the floating ova in the sea, but this is unlikely.

More than once the eggs of the haddock and other fishes have been brought under notice as lying on the bottom of a vessel, and therefore held as proving that the ova did not float; but in every case such eggs were found to be dead, dying, unripe, or unfertilized. If, in removing the eggs from a fish, too much pressure is applied, unripe eggs escape. Such either sink or float ambiguously, according to the stage of development. Unless this fact is borne in mind disappointment naturally occurs, especially to one who has triumphantly carried such eggs from deep-sea fishing to vindicate statements that have been impugned. No one ever asserted that dead eggs floated. It is the ripe and living eggs that are so buoyant.

In the marine laboratory it has happened that some living ova of the cod rolled on the bottom of the vessel, but this was clearly due to the attachment of fine particles of mud and sand which had gained admission from imperfections in the temporary apparatus, and which surely and speedily in every case proved fatal to the embryo.

The ova and embryos brought from the surface of the sea are comparatively hardy, even though kept for ten days without renewal of the sea-water. The lively little cod, about 5^{mm}. in length, with their characteristic black pigment-patches, swam actively at the surface of the water, darting hither and thither when interfered with, while a stratum of the dead lay at the bottom. The water may even be somewhat milky and the odor characteristic, and yet the embryos survive until, as Professor Sars also found, the yelk-sac, which supplies them with nourishment, is absorbed.

The difference between the larval cod and the young salmon just hatched is striking. The former is in a very rudimentary condition, not only in size, but in structure. For instance, the heart pulsates, but as my colleague, Professor Pettigrew, observed, there is no visible blood and no blood-vessels. Those, therefore, who say that the heart in animals contracts from the stimulus of its living blood, would here find little support. On the other hand, the newly-hatched salmon has attained considerable complexity of structure, and its blood-vessels are well elaborated.

ST. ANDREW'S, SCOTLAND, *November* 10, 1886.

19.—CROAKING OF THE PERCH.

By W. R. HAMILTON, M. D.

My observations with regard to the croaking or grunting noise made by the Drumfish family have been confined to the fish known here as the "Perch" (*Haploidonotus grunniens*). This fish, as is well known, is furnished with a masticatory apparatus in the gullet, and the lower division of this has its upper surface flat and triangular in outline, and studded all over with spheroidal "teeth," if they may be called genuine teeth. The upper division is composed of two parts united by a ligament; their lower surfaces are also supplied with similar teeth. The divisions of this apparatus have powerful muscles attached to them by which they can be pressed together and moved laterally on each other. By this process the fish masticates the crustaceans on which it feeds. When this action takes place, the teeth coming in contact and gliding over each other produces the croaking of the perch.

About twenty years ago, for the purpose of endeavoring to ascertain by what means the croaking of the perch was produced, I procured from an Ohio River fisherman a perch weighing 18½ pounds, which he declared was the largest perch he had ever caught. I divided the head on one side, and thus exposed its masticatory apparatus; and while moving its grinders as I supposed the fish had done during life when crushing a crawfish, an exact imitation of the croaking of the perch was produced. I produced the sounds in a similar manner within the hearing of several Allegheny River raftsmen and Ohio River fishermen at intervals during the day on which I experimented, without allowing them to know how the noises were made, or that a perch was used for the purpose, and they all declared that it was an exact imitation of the croaking of the perch. This noise is made, I believe, only at the season of the year when the perch "bites" or feeds. The above experiment and others of a similar kind lead me to believe firmly that the croaking of the perch is produced in the manner referred to. I cannot conceive of any way by which the sound could be produced by the air-bladder of the fish, as its physiological functions and anatomical structure do not indicate its use as a vocal organ.*

PITTSBURGH, PA., *April* 30, 1887.

---

* Prof. John A. Ryder, in a letter commenting on the above, May 21, 1887, said: "It is now known that certain sound-producing fishes give out noises by grating certain bones together in a peculiar way. An extensive memoir by a Danish author has appeared within two years, the Danish title of which has escaped me, but which deals with this question at great length, with fine illustrations. The usual view, that the air is forced from one part of the air-bladder to another in the Sciænoids, seems to me inadequate in the absence of clearly worked-out demonstrations. This group is physoclystous, or has the air-bladder entirely closed."

20.—WHITEFISH DISTRIBUTED FROM NORTHVILLE AND ALPENA STATIONS.

By FRANK N. CLARK.

From March 25 to May 24, 1887, the distribution of whitefish fry from Northville and Alpena stations was as follows:

NORTHVILLE STATION.

Date.	Water where deposited.	Place near which.	No. of fry.
1887.			
Mar. 25	Lake Michigan	Ludington, Mich	3,000,000
27	Saginaw Bay, Lake Huron	Bay City, Mich	3,000,000
31	Lake Michigan	Grand Haven, Mich	3,000,000
Apr. 2	do	Ludington, Mich	3,000,000
5	Lake Erie	Monroe, Mich	3,000,000
6	Lake Michigan	Michigan City, Ind	3,000,000
9	Lake Ontario	Oswego, N. Y	3,000,000
12	Lake Erie	North Bass Island, Ohio	3,000,000
13	do	Monroe, Mich	3,000,000
18	do	Sandusky, Ohio	3,000,000
20	Lake Michigan	Saint Joseph, Mich	3,000,000
	Total		33,000,000

ALPENA STATION.*

Date.	Water where deposited.	Place near which.	No. of fry.
Apr. 30	Thunder Bay, Lake Huron	Whitefish Point, Mich	3,000,000
May 2	do	Sulphur Island, Mich	3,000,000
3	Lake Huron	Alcona, Mich	3,000,000
4	do	do	3,000,000
6	Thunder Bay, Lake Huron	North Point, Mich	3,000,000
7	Lake Huron	Oscoda, Mich	3,000,000
8	do	do	3,000,000
11	do	Detour, Mich	2,000,000
16	Lake Michigan	Thompson, Mich	2,000,000
17	Thunder Bay, Lake Huron	North Point, Mich	1,000,000
18	do	Whitefish Point, Mich	1,000,000
19	Lake Huron	Sand Beach, Mich	2,000,000
20	Long Lake	Alpena County, Michigan	20,000
24	Clear Lake	Oscoda County, Michigan	50,000
	Total		29,070,000

*These shipments were all made by boat direct from Alpena.

Summary of fry from Northville and Alpena planted in the Great Lakes, spring of 1887.

Lake Huron	30,000,000
Lake Michigan	17,000,000
Lake Erie	12,000,000
Lake Ontario	3,000,000
Clear Lake	50,000
Long Lake	20,000
Total	62,070,000

Summary by States.

Michigan	50,070,000
Ohio	6,000,000
Indiana	3,000,000
New York	3,000,000

Vol. VII, No. 5. Washington, D. C. June 30, 1887.

21.—BEST SEASON FOR PACKING SALMON ON THE PACIFIC COAST.*

By LIVINGSTON STONE.

There can be no question about the flesh of the California salmon (*Oncorhynchus quinnat*) being better for canning in the spring than in the fall. It is incomparably better. It is so much better that it has always been universally admitted to be so, and I have never heard a doubt expressed about it before. In the spring the salmon are well-fed, plump, handsome, fat, silvery fish, covered with bright and hard scales. In the fall they are, at the best, thin, slab-sided, with nothing in their stomachs; their silvery appearance is entirely gone, the fat has disappeared from their flesh, and they are covered with a slimy skin instead of hard scales. In the spring they are fresh from their feeding-grounds in the ocean, and are in as fine condition as a salmon can be. In the fall their stomachs have been empty, sometimes for weeks and months, and all this while their flesh has been deteriorating.

The difference between the flesh of the spring salmon and that of the fall salmon is the difference between the flesh of an animal in prime condition and one in an exhausted condition. The explanation of the difference is at the same time a proof of the existence of it, for the salmon spawn in the fall, and this sufficiently explains why they are not in good condition at that time, and is also unquestionable evidence that they are in poor condition. I have handled hundreds of thousands of salmon in the fall and am thoroughly familiar with them at that season, and I am very much surprised that any question has ever been raised concerning the superiority of the spring salmon for canning.

---

*This article was written as a response to the following letter of inquiry from Mr. F. N. Barrett, editor of the American Grocer, of New York, dated April 27, 1887, addressed to Prof. S. F. Baird, and by him referred to Mr. Stone:

"During the winter a very animated discussion was carried on among certain packers of salmon regarding the relative merits of spring and fall packed fish. It is claimed by some that fish packed in September or later are unfit for food. I have before me, from the Portland (Oreg.) News, of March 25, 1887, a statement from Mr. Samuel Elmore, of Astoria, Oreg., a salmon packer on Tillamook Bay and Siuslaw River, who says that fall salmon are a good and eatable article. He claims that salmon caught late in the fall are freely eaten in a fresh condition, and that if good in that way they are equally good for canning. It was claimed that salmon were caught and packed up to December 1, 1886, on Tillamook Bay, and that fish taken so late in the season are exhausted, sickly, and slimy. Others hold that if a salmon has strength enough to return from the spawning ground and seek the ocean, it is just as good for food as salmon taken and packed during April, May, June, or July. Can you give me the opinion of your expert regarding this question? Is there any noticeable difference in the texture or flavor of fish taken during October, November, or December, as compared with those taken during May, June, or July? The opinions on this subject obtained from the salmon packers differ widely and are colored by interest, while the question is now one of great importance to the trade."

The statement which has been made that the fall salmon is unfit for food is not, however, by any means true. The flesh of the salmon is entirely different at that season, and inferior; but if the fish is not too far spent, it is not unfit for food. Indeed, it makes, when very fresh and well cooked, a decidedly edible dish.

Many salmon, however, in the fall become blind and very much emaciated, lose much of their fins and tail, and become covered with white blotches of fungus, being altogether very repulsive in appearance. On the whole, I should say that fall salmon are fish that one should be very cautious about canning, as the flesh is inferior, spoils very soon, and might possibly be furnished by unscrupulous persons from fish too far gone to be wholesome.

On the other hand, I must say that the Indians eat the fall salmon even in their most advanced stages of emaciation and disease, and never seem to suffer any ill effects from it. Furthermore, there is a salmon or trout in the Columbia River called the "square-tailed salmon" (or "trout") (*Salmo truncatus* Suckley), which spawns in spring. This fish, of course, is in its best condition in fall and early winter, and there can consequently be no objection to its being canned at that time.

CHARLESTOWN, N. H., *May* 16, 1887.

32.—THE FISHERIES OF GLOUCESTER, MASS., IN JANUARY, 1887, WITH NOTES ON THOSE OF OTHER LOCALITIES.

By W. A. WILCOX.

During the month of January only a small portion of the fishing fleet has been actively employed. Receipts have been light, not varying much from those of the corresponding month of one year ago. For several years the new year has opened with a market overstocked with both domestic and imported fish, and prices so low as to scarcely pay the cost of production, but during the present month a largely increased and steady demand has reduced stocks, and prices have slowly advanced.

Since the beginning of the year much rough weather has been encountered, but there have been no serious losses of life or property, and much encouragement is felt in making preparations for the work of 1887.

Bait has been found abundant on the fishing banks, and additional quantities have been supplied from the cargoes of frozen herring brought from Newfoundland and the Bay of Fundy.

A few vessels have followed the fresh halibut fishery on the Grand Bank. These arrived with small fares, and reported much rough weather. The shore fleet has been detained in the harbors adjacent to the fishing grounds a large part of the month, the weather preventing extensive fishing. The Bay of Fundy herring catch has been light. Schooner Ada R. Terry, of Gloucester, arrived on January 5th with a cargo of 210,000 frozen herring in number. This was the first cargo landed during the season. Vessels that went to Newfoundland for frozen herring are now arriving with full cargoes and report herring of good size and quality to have been plentiful.

When the weather has been favorable the U. S. Fish Commission schooner Grampus, Captain Collins, has engaged in collecting codfish spawn direct from the fishing grounds near Cape Ann and carrying them to the hatching station at Wood's Holl. She has also brought large quantities of young fish from the hatchery and turned them loose in the in-shore waters. The Grampus and other boats of the U. S. Fish Commission from Wood's Holl have during the season planted about 20,000,000 young codfish in the vicinity of Cape Cod. This branch of the work has been prosecuted with success, the amount of eggs procured and hatched being limited only by the unfavorable weather that has much of the time prevented the taking of eggs on the fishing grounds.

The annual meeting of the Menhaden Oil and Guano Association was held at New York on January 12th. This fishery was formerly extensively prosecuted as far north as the coast of Maine, but is now confined to the coast between Narragansett Bay and North Carolina. During the past season the fish have been found in abundance and the members of the association report an average production of oil and scrap.

Fish landed at Gloucester by the fishing fleet in January, 1887.

Fishing grounds.	Number of fares.	Salt cod.	Fresh halibut.	Salt haddock.	Frozen herring.	Pickled herring.
By Gloucester vessels:		*Pounds.*	*Pounds.*	*Pounds.*	*Number.*	*Barrels.*
Western Bank	1	50,000				
Grand Bank	15		392,500			
Banquereau	1		15,000			
George's Bank	14	236,000	43,100			
Bay of Fundy	4				790,000	
Fortune Bay, Newfoundland	6				2,360,000	180
Barren Island, Newfoundland	1				50,000	1,100
New England shore:						
Trawl fishery	46	326,300		2,000		
Gill-net fishery	15	29,000				
By small boats		27,800				
Total	103	669,100	450,600	2,000	3,200,000	1,280
By vessels belonging at other ports:*						
New England shore:						
Gill-net fishery	3	9,800				
Trawl fishery	5	58,500				
Grand Bank	1		25,000			
Total	9	68,300	25,000			
Total, January, 1887	112	737,400	475,600	2,000	3,200,000	1,280
Total, January, 1886	64	510,000	517,800	15,000	4,361,000	220

NOTE.—The miscellaneous receipts from other ports consisted of 50 barrels pickled herring by the Boston and Maine Railroad.

*These fish were landed by the following schooners: Flora Temple, of Portland, Me.; Franklin Schenck and Mary S. Hontvet, of Portsmouth, N. H.; Eliza, of Marblehead, Mass.; E. A. Williams, of Boston, Mass.; Estelle S. Nunan and E. L. Sanborn, of Rockport, Mass.

23.—THE FISHERIES OF GLOUCESTER, MASS., IN FEBRUARY, 1887, WITH NOTES ON THOSE OF OTHER LOCALITIES.

By W. A. WILCOX.

During February the work of another year has been actively entered upon, although a large number of the fishing vessels will not sail until later. The month has been more than usually stormy, and unfavorable for fishing, and on that account the receipts have been below the average. A good and steady demand has called for all fish arriving, and for much of the old stock that was on hand. Prices have been reasonably low, yet enough higher than of late to give much encouragement for the future. This feeling of confidence is indicated by the renewal of work at the formerly deserted ship-yards in Essex and Gloucester, where fifteen new fishing vessels and one whaler are now building. On George's cod and halibut have been scarce, the receipts being much below the average. In Ipswich Bay cod of large size and fine quality have been abundant, both the trawl and net fishermen obtaining good catches, although comparatively few nets were employed.

Herring have not been as abundant as usual in the Bay of Fundy. The catch has been short all the winter, and as a result fewer vessels have been engaged. At Fortune Bay, Newfoundland, and vicinity herring have been very plentiful. The only vessels from the United States that engaged in the Newfoundland herring trade were from Gloucester. One vessel is frozen in at one of the harbors, but the others have secured full fares and most of them have already returned.

With the close of the month the time is near for the early catch of mackerel to receive attention, and for vessels to begin preparation for their southern trips. The close season mackerel bill has been passed and signed. This bill goes into effect in 1888, and continues in force five years. This is, therefore, the last season for some time that any mackerel vessels can begin fishing before June, and no mackerel caught before that date by foreign vessels can be imported. The coasting schooner, S. M. Bird, at Philadelphia, from the South, reported having seen numerous schools of mackerel during the month, in latitude 33° 49′, longitude 76° 50′. As none were caught by the crew of the vessel, there is no positive proof that the schools seen were mackerel, and the Gloucester fishermen think they were some other species.

During the month three fine vessels from Gloucester have been reported lost. The schooner Carthage, 67.27 tons, sailed from the home port November 30, 1886, bound for George's Bank, and a fare of codfish. She has not been heard from since, and, with her crew of twelve men, has at last been given up. She was insured in home office for $3,403 on vessel, and $1,000 on outfits. The schooner Ocean King, 75.81 tons, sailed from Gloucester on a halibut trip January 18. A few days later, while at anchor on St. Peter's Bank, she encountered a severe storm; everything on deck that was movable was washed overboard; the rudder was damaged, and soon the vessel became wholly unmanageable. From January 22 till February 9 the vessel drifted a floating wreck. When near Sable Island she was discovered by the fishing schooner C. B. Manning, and with much difficulty the crew was rescued, after which the vessel was set on fire. The schooner Phil Sheridan, 93.68 tons, sailed from Gloucester February 23, bound for George's Bank. Two days later, in latitude 42° 06′, longitude 66° 50′, she encountered a severe gale, and while hove to was struck by a heavy sea and thrown on her beam ends, and the masts and sails and the nine dories were carried away. The vessel soon righted, but was a complete wreck. Schooner Dido, of Gloucester, took it in tow for six hours, but was then obliged to turn it adrift, owing to the rough seas. On the 27th of the month the steamer Peconic, Captain Evans, master, from Messina, fell in with the wreck 120 miles from Boston Light, and took the crew off and carried them to Boston. The vessel was set on fire before leaving. The master and crew express heartfelt thanks to the officers of the steamer for their kindness. The schooner was insured for $6,037, and her outfit for $500.

Such, in brief, is the account of the loss of three fine fishing vessels, one with all hands. How and when it was lost will probably never be known. The crews of the other two vessels suffered severely from cold, hunger, and exposure, but after a few days of rest these same men could once more be found on other fishing vessels bound for the distant fishing-banks. No disasters or suffering appear to have a check on the men following the fisheries, or in any manner frighten them from the dangers of winter fishing on the distant banks in mid-ocean. Men are always ready to man the vessels, and seem much more anxious to go than the owners of the vessels are to send them during the winter.

Fish landed at Gloucester by the fishing fleet in February, 1887.

Fishing-grounds.	Number of fares.	Salt cod.	Fresh halibut.	Frozen herring.	Pickled herring.
	Pounds.	*Pounds.*	*Pounds.*	*Number.*	*Barrels.*
By Gloucester vessels:					
George's Bank	56	1,136,000	186,800		
Western Bank	2	57,000	18,200		
Grand Bank	16		421,000		
La Have Bank	1		18,000		
Banquereau	2		50,000		
Off Sable Island	2		110,000		
Fortune Bay, Newfoundland	18			6,583,000	915
Bay of Fundy	3			855,000	
Ipswich Bay and off Cape Ann	60	349,000			
Off Cape Ann (by small boats)		18,000			
Total	160	1,560,000	804,000	7,438,000	915
By vessels belonging at other ports:[*]					
Ipswich Bay and off Cape Ann	11	97,000			
Total in February, 1887	171	1,657,000	804,000	7,438,000	915
Total in February, 1886	146	2,143,000	927,800	7,907,000	

NOTE.—The miscellaneous receipts from other ports during the month consisted of 700 barrels of mackerel from Halifax, Nova Scotia.

[*] These fish were landed by the following vessels: Schooner Flora Temple, of Portland, Me.; schooner Grace Choate, of Portsmouth, N. H.; schooner Eliza, of Marblehead, Mass., and schooners Clara Grimes, Edith Conley, and Estelle S. Nunan, of Rockport, Mass.

24.-THE FISHERIES OF GLOUCESTER, MASS., IN MARCH, 1887, WITH NOTES ON THOSE OF OTHER LOCALITIES.

By W. A. WILCOX.

During a large part of the month the weather was so stormy as to seriously interfere with fishing, and many vessels lost anchors, cables, and deck-gear, but they escaped serious disaster.

The leading receipts of the month have been cod, halibut, and frozen herring. On George's Bank cod and halibut have been scarce; old fishermen report them more so than for twenty-five years, but the decreased receipts are accounted for, in part at least, by the weather, which was unfavorable for fishing. In Ipswich Bay a fleet of sixty sail has found codfish both abundant and large in size. The fish were mostly taken with trawls, the largest catches being made where the trawls were most numerous; the thousands of baited trawls apparently attracting the fish.

Halibut receipts were mostly from 18 to 20 miles ENE. of Sable Island. These grounds have of late years been seldom visited by American fishermen, but fish were recently found plentiful there, about two-thirds of the catch being white halibut. The few vessels fishing on the Grand Bank have had a moderate catch of halibut, though they met with much drift ice, which in many cases carried away their trawls. Fish from this locality averaged only one-half white.

The Western Bank codfish fleet have begun to sail for the fishing-grounds. A larger proportion than usual will fish with hand-lines and salt-clam bait, instead of using trawls and fresh bait, as formerly. By this means they will avoid the necessity of visiting any foreign port except for wood, water, shelter, or repairing damages. It is reported that about 7,000 barrels of clam bait have been sold to provincial fishermen by dealers in Maine.

Fourteen sail of cod-fishermen are reported as having started for the Western Bank from Booth Bay and Southport, Me. Provincetown will this season have a reduced fleet engaged in the cod and mackerel fisheries, as a number of the vessels have been sold, some of them having left the country and no new ones have been added. That port during the month has had twenty-two vessels engaged in catching fresh fish for the Boston market.

The schooner Grampus, of the U. S. Fish Commission, has done good work in gathering codfish eggs for the hatchery at Wood's Holl, and in turning loose the young fry. Much time has been lost by rough weather, yet the millions of eggs gathered, hatched, and turned out into the waters of Massachusetts Bay may reasonably be expected to produce good results in the future. Her work in this line for the season ends with March, as she is to go south to meet and follow the mackerel, alewife, bluefish, and other migratory fish, concerning which much important information is yet to be obtained.

The spring mackerel fleet have been actively engaged in making ready for the work of the season. The first vessel to start, the schooner Mayflower, sailed from Gloucester on March 11, and was followed during the month by the steamer Novelty and 38 other mackerel vessels hailing from Maine and Massachusetts ports. Up to the close of the month no mackerel have been caught or seen.

A few vessels from Gloucester will go to Flemish Cap for codfish, but probably none will visit the Greenland coast this year. The Gloucester schooners Davy Crockett and Arthur D. Story sailed on halibut trips to the coast of Iceland on March 23, followed, two days later, by the Annie M. Jordan. The schooner Concord will soon sail for the same locality. No other American fishing vessels are expected to visit Iceland during the season.

Fish landed at Gloucester by the fishing fleet in March, 1887.

Fishing grounds.	Number of fares.	Codfish.	Halibut.	Frozen herring.	Pickled herring.
		Pounds.	*Pounds.*	*Number.*	*Barrels.*
By Gloucester vessels:					
George's Bank	121	3,176,000	177,900		
Grand Bank	13	6,000	312,400		
Off Sable Island	13		556,709		
Bay of Fundy	4			861,000	
Fortune Bay	2			725,000	160
Ipswich Bay	21	400,000			
Off New England shore	53	173,400			
Off New England shore (by small boats)		6,000			
Total	227	3,761,400	1,047,000	1,586,000	160
By vessels belonging at other ports:*					
Ipswich Bay	7	77,000			
Off New England shore	3	6,900			
Grand Bank	1		25,000		
Bay of Fundy	1			140,000	
Total	12	83,900	25,000	140,000	
Total in March, 1887	239	3,845,300	1,072,000	1,726,000	160
Total in March, 1886	190	4,568,334	1,106,100	1,860,000	

NOTE.—The miscellaneous receipts from other ports during the month consisted of 1,000 boxes smoked herring, 1,650 quintals hake, 100 quintals cod, 25 quintals haddock, 25 quintals cusk, and 21 barrels fish-oil from Maine; and 1,675 barrels fish-oil from Tiverton, R. I.

* These fish were landed by the following schooners: Venus, of Eastport, Me.; A. C. Newhall, of New Castle, N. H.; Franklin S. Schenck and Mary S. Hontvet, of Portsmouth, N. H.; E. A. Williams, of Boston, Mass.; Mary E. Story, of Swampscott, Mass.; and Clara R. Grimes, Estelle S. Nunan, and Edith Conley, of Rockport, Mass.

25.—NOTES ON THE FROZEN-HERRING TRADE WITH NEWFOUNDLAND AND THE BAY OF FUNDY DURING THE WINTER OF 1886-'87.

By W. A. WILCOX.

The frozen-herring business of the past winter closed early in April.

The Newfoundland trade, in which twenty-seven vessels from Gloucester were engaged, was quite successful. The first one in search of frozen herring sailed on November 20, the last on January 21. The first arrival at the home port with frozen fish was on January 7, and the last on March 8. Herring of large size and good quality were found very abundant both at Fortune and Placentia bays. Twenty-six cargoes were secured at the former and two at the latter place, while one vessel in search of pickled herring sailed as early as September 17, securing her cargo at Bay of Islands. Unfortunately one schooner was caught in the ice at one of the harbors of Placentia Bay before taking any herring on board, and still remains ice-bound. All of the others secured full cargoes, and three made two trips apiece. All arrived home in safety and found a ready market for their herring at reasonable and satisfactory prices, selling mostly at $1 per hundred, count. The bulk of the receipts was used for bait. A few cargoes found sale at New York and Philadelphia, these being chiefly used for food.

The following table gives the detailed account of the herring business with Newfoundland for the winter of 1886-'87 by Gloucester vessels, these being, as far as known, the only American vessels employed in the trade. In addition to these, at least two Provincial vessels, namely, the Anna Robinson and the Festina Lenta, carried cargoes of frozen herring from Newfoundland to New York.

Quantity of frozen and pickled herring brought from Newfoundland by Gloucester vessels, from December 2, 1886, to March 8, 1887.

Name of vessel.	Date of sailing.	Date of return.	Frozen herring.	Pickled herring.	Where obtained.	Where sold.
			Number.	*Barrels.*		
Cecil H. Low	Nov. 20, '86	Jan. 7, '87	400,000	....	Fortune Bay	Gloucester, Mass.
Cecil H. Low (second trip).	Jan. 21, '87	Feb. 16, '87	350,000	....	....do	Do.
Jennie Seaverns	Dec. 1, '86	Feb. 1, '87	400,000	....	....do	New York, N. Y.
Spencer F. Baird	Dec. 1, '86	Feb. 1, '87	350,000	40	....do	Philadelphia, Pa.
A. R. Crittenden	Dec. 11, '86	Feb. 7, '87	320,000	30	....do	Gloucester, Mass.
Gertie Evelyn	Dec. 3, '86	Feb. 1, '87	350,000	50	....do	Do.
Orient	Dec. 3, '86	Feb. 1, '87	450,000	100	....do	New York, N. Y.
Davy Crockett	Dec. 1, '86	Jan. 31, '87	350,000	40	....do	Gloucester, Mass.
Herman Babson	Dec. 10, '86	Feb. 4, '87	350,000	40	....do	New York, N. Y.
Samuel V. Colby	Dec. 11, '86	Feb. 7, '87	380,000	50	....do	Do.
Isaac A. Chapman	Dec. 14, '86	Feb. 24, '87	330,000	40	....do	Philadelphia, Pa.
Centennial	Dec. 15, '86	Feb. 17, '87	420,000	60	....do	New York, Y. Y.
Nellie M. Davis	Dec. 28, '86	Feb. 15, '87	300,000	50	....do	Gloucester, Mass.
Mayflower	Nov. 28, '86	Jan. 15, '87	400,000	75	....do	Do.
William H. Jordan.	Nov. 22, '86	Feb. 4, '87	350,000	50	....do	New York, N. Y.
Maggie and Lilly	Nov. 24, '86	Feb. 7, '87	333,000	30	....do	Gloucester, Mass.
Rattler	Nov. 24, '86	Jan. 29, '87	400,000	....	....do	Do.
Porter S. Roberts	Nov. 24, '86	Feb. 2, '87	340,000	50	....do	Do.
Molly Adams	Nov. 27, '86	Jan. 8, '87	50,000	1,100	Placentia Bay	Do.
Molly Adams (second trip).	Jan. 18, '87	Mar. 7, '87	425,000	100	Fortune Bay	Do.
Arthur D. Story	Sept. 17, '86	Dec. 2, '86	....	800	Bay of Islands.	Do.
Arthur D. Story (second trip).	Dec. 20, '86	Feb. 3, '87	350,000	60	Fortune Bay	Do.
Harry G. French	Jan. 2, '87	Feb. 17, '87	400,000	100	Placentia Bay	Do.
Marguerite	Jan. 2, '87	Feb. 4, '87	400,000	60	Fortune Bay	New York, N. Y.
*John W. Bray	Jan. 18, '87	....	....	....	....	....
Alice C. Jordan	Jan. 21, '87	Mar. 8, '87	300,000	60	Fortune Bay	Gloucester, Mass.
Mystery	Nov. 26, '86	Feb. 7, '87	500,000	50	....do	Philadelphia, Pa.
William D. Daisley	Nov. 26, '86	Feb. 4, '87	360,000	60	....do	New York, N. Y
John G. Whittier	Jan. 7, '87	Feb. 16, '87	380,000	50	....do	Gloucester, Mass.
James and Ella	Dec. 11, '86	Jan. 28, '87	360,000	....	....do	Do.
Total	....	....	10,118,000	3,145		

* Schooner John W. Bray was frozen in at one of the harbors of Placentia Bay soon after reaching there, and still remains ice-bound.

The Bay of Fundy frozen herring business during the past winter has been much below the average. Herring were scarce much of the time, and the business was more or less restricted by our fishery complications with the Provinces. The following table gives the quantities brought by Gloucester vessels:

Quantity of frozen herring brought from the Bay of Fundy by Gloucester vessels during the winter of 1886–'87.

Name of vessel.	Date of arrival at Gloucester.	Number of frozen herring.	Where obtained.
Ada R. Terry	Jan. 5, '87	210,000	Grand Manan.
Ada R. Terry (second trip)	Mar. 9, '87	260,000	Do.
Enola C	Jan. 17, '87	180,000	Saint George.
Enola C (second trip)	Mar. 9, '87	250,000	Do.
Margie Smith	Feb. 14, '87	250,000	Welsh Pool.
Margie Smith (second trip)	Apr. 4, '87	180,000	Saint George.
William H. Foye	Jan. 21, '87	220,000	Do.
William H. Foye (second trip)	Mar. 9, '87	60,000	Do.
Volunteer	Feb. 14, '87	255,000	Do.
Commonwealth	Feb. 24, '87	350,000	Do.
Sarah P. Ayer	Mar. 4, '87	250,000	Beaver Harbor.
Clyde	Mar. 12, '87	101,000	Saint George.
Total		2,566,000	

After touching and reporting at Gloucester, a few of these vessels proceeded to Boston and disposed of their fish for bait and food, though the larger portion was sold at Gloucester for bait.

The cargoes mentioned in the above table constituted the bulk of the receipts by American sailing vessels from the Bay of Fundy, though the schooners Venus and Flora Wooster, of Eastport, brought 320,000 and 53,000, respectively, and the Charles H. Kelley, of Boston, brought 160,000. The fish brought by the first-named vessels were obtained at Saint George, and those by the last-named from Grand Manan. In addition to those brought by sailing craft, large quantities of frozen herring were shipped by rail and steamer from Eastport and other fishery centers, to the principal markets of the New England and Middle States.

26.—THE FISHERIES OF GLOUCESTER, MASS., IN APRIL, 1887, WITH NOTES ON THOSE OF OTHER LOCALITIES.

By W. A. WILCOX.

Although April is a spring month, the weather has much resembled that of midwinter, with heavy falls of snow occurring so late as the 18th. The cold weather and frequent storms have considerably delayed the vessels in beginning their season's work. During the month comparatively few Gloucester vessels have been employed, these fishing mostly on George's Bank and off Cape Ann, though a small fleet has fished on the Western Bank for cod and halibut.

During the recent severe gales a number of vessels have found it desirable to use oil in breaking the force of the seas. This practice is growing in favor among the Gloucester fishermen, and at least one vessel is claimed to have been saved in this way during the month. This vessel, the schooner Willie M. Stevens, while on her homeward passage, encountered a heavy gale and came to anchor off Cashe's Ledge. Her anchor failed to hold, and it was by the use of oil that she was enabled to prevent the seas from breaking over her.

Codfish have been scarce on George's and Western Banks, and the vessels from these localities have, with few exceptions, returned with small fares. On the shore-grounds off Cape Ann and in Ipswich Bay, however, they have been very abundant. This abundance has been especially noticeable on the fishing grounds, 3 to 5 miles southeast from Eastern Point, where cod of large size and fine quality are reported to have been more plenty than for years. During the greater part of the month the vessels fishing in that locality have had large catches. Some of these vessels, with crews of ten men, have left the harbor for the fishing grounds in the early morning and returned before dark with from 12,000 to 15,000 pounds of codfish, while the dory fishermen have frequently caught from 800 to 1,000 pounds per day. On these grounds trawls and hand-lines were employed, the bulk of the fish being taken by the trawl fishermen. In Ipswich Bay trawls, hand-lines, and gill-nets were used, but by the 25th of the month most of the nets were laid aside. The large catch in the in-shore waters has offset to a considerable extent the light receipts from the distant banks, thus bringing the total receipts for the month nearly up to those of April, 1886.

During the winter of 1878-'79, the United States Fish Commission began the propagation of codfish at Gloucester, hatching out several millions of young cod, which were placed in the waters near Eastern Point, and the unusual abundance of fish on these grounds is by many attributed to the stocking of these waters by the Fish Commission at that time.

Owing to the cold and backward spring, the mackerel fleet have been considerably delayed in starting for the southern fishing grounds, but at the end of the month fifty-two vessels from Gloucester and other ports had sailed. The schooner Grampus, of the United States Fish Commission, sent out to study the habits of the mackerel, is reported as having taken the first fish, these being obtained on April 8, in gill-nets, about 50 miles east from Cape Charles. The schooner Caroline Vaught, of Boothbay, was the first to land fresh mackerel in New York. She secured about 10,000 medium-sized fish 50 miles east of Hog Island, in lat. 37° 20′ N., and long. 74° 30′ W., on April 21, this locality being nearly identical with that where mackerel were first taken in 1886.

Between 1876 and 1880 no mackerel were taken by the southern fleet prior to April 2, the first catches being, respectively, on the 25th, 26th,

6th, 13th, and 2d of that month. From 1881 to 1885, inclusive, the first catches were made in March, these being obtained in 1881 on the 22d, in the three following years on the 31st, and in 1885 on the 28th. Last year the first fish were seined on the 10th of April.

The vessels fishing on George's during the present month have reported finding several good-sized mackerel in the stomachs of the codfish. At its last session Congress passed a bill prohibiting the landing or importation of mackerel caught prior to June 1. This bill goes into effect next season, and continues in operation for five years. This is, therefore, the last season for some time during which the spring mackerel fishing can be prosecuted.

During the month numerous traps and weirs have been put in fishing order along various portions of the New England coast, these being intended to supply the vessel-fishermen with bait, although many will ship their catch fresh to be used for food.

The receipts of halibut have been much below those of April, 1886; those landed at Gloucester being chiefly from the fishing grounds off Sable Island. Halibut are also reported to have been quite abundant off Nantucket Shoals.

Fish landed at Gloucester by the fishing fleet in April, 1887.

Fishing grounds.	Number of fares.	Codfish.	Halibut.	Haddock.	Herring.
By Gloucester vessels:		*Pounds.*	*Pounds.*	*Pounds.*	*Number.*
George's Bank	101	1,806,500	96,400	78,000	
Off Sable Island	11		876,000		
Grand Bank	8		192,000		
Western Bank	42	1,592,000	60,200		
Brown's Bank	2	40,000	3,500		
Banquereau	1		16,000		
Ipswich Bay	15	88,100			
Off Cape Ann	90	434,600		69,550	
Bay of Fundy	1				*180,000
New England shore (small boats)		40,000		12,200	
New England shore (traps)					39,000
Total	271	4,001,200	744,100	159,750	219,000
By vessels belonging at other ports:†					
Off Cape Ann	13	49,100		7,400	
Ipswich Bay	8	68,000			
Jeffrey's Bank	1	10,000			
Total	22	127,100		7,400	
Total for April, 1887	293	4,128,300	744,100	167,150	219,000
Total for April, 1886	212	4,214,900	1,303,600	155,000	
Total for April, 1885	250	4,592,000	978,710	185,000	

* Frozen.

† These fish were landed by the following schooners: David A. Osier, of Matinicus, Me.; B. A. Baker, of Jonesboro', Me.; Grace Choate, and Comet, of Portsmouth, N. H.; E. A. Williams, and Julia A., of Boston; Florence Nightingale, and Mary Story, of Swampscott, Mass.; Edith L. Conley, of Rockport, Mass.; and Eliza, of Marblehead, Mass.

NOTE.—The miscellaneous receipts from other ports during the month consisted of 6,183 boxes of smoked herring from Maine.

GLOUCESTER, MASS., *June* 15, 1887.

37.—THE FISHERIES OF GLOUCESTER, MASS., IN MAY, 1887, WITH NOTES ON THOSE OF OTHER LOCALITIES.

By W. A. WILCOX.

Notwithstanding a backward season and the almost continuous cold, foggy weather, the fisheries have been actively prosecuted during the month, and the receipts, while not large, have been in excess of those of May, 1886. The demand has improved, but the receipts have been ample to supply the trade at fairly remunerative prices.

Codfish have been reported scarce on many of the distant fishing grounds, especially on George's Bank; but they have been more than ordinarily abundant on Western Bank and in the shore waters off Cape Ann. The large school of cod found in these waters in April has remained in the vicinity, and the Gloucester shore fleet have found excellent fishing throughout the month in the immediate vicinity of the harbor. On May 5 the schooner Northern Eagle, with a crew of ten men, secured 24,000 pounds of cod on the local grounds, 3 to 5 miles southeast from Eastern Point—the eastern extremity of the harbor.

On May 8 nine vessels landed a total of 176,000 pounds of codfish, as the result of two days' fishing with trawls. The following statement shows the catch of each of the vessels separately and the number of men constituting the crew:

Vessel.	No. of men.	Catch.
		Pounds.
Schooner Abbie A. Snow	12	43,000
Schooner Rising Star	10	38,000
Sloop Dixey	10	40,000
Sloop Breeze	4	18,000
Sloop Teddie	3	10,000
Schooner Chromo	4	9,000
Schooner Gracie	4	7,000
Schooner Optimatus	2	6,000
Schooner Julia A	4	5,000

In addition to the above, each of these vessels landed a few hundred pounds of haddock. The boat-fishermen also had a large catch on the same grounds with hand-lines. The fishing in Ipswich Bay, on the north side of Cape Ann, was also much better than in May of 1886.

The receipts of fresh halibut show a gain over the corresponding month of last year. The schooner Willie M. Stevens arrived on May 13, with 74,000 pounds caught on Grand Bank; this being the largest fare landed during the month. The prices at that time were, owing to the oversupply of halibut, lower than at any previous period during the year, the cargo selling at 2½ cents a pound. The schooner O. B. Manning, while on a halibut trip, went ashore on Gannet Ledge, Nova Scotia. The crew were saved, but the vessel proved a total loss. Of the Gloucester fleet visiting the coast of Iceland for halibut during the present season, the Davy Crockett was the first to arrive there. She reached the fishing grounds on April 8, nineteen days after leaving Gloucester. The second vessel to arrive was the schooner Annie M. Jordan, after a passage of twenty-three days. Halibut were reported as abundant, though it was said that the only fishing by the natives was for sharks. Capt. John Cousins, of the schooner Annie M. Jordan, writes that on the passage, while in latitude 59° 20′, longitude 30° 10′, he sailed through vast quantities of dead fish, extending a distance of 5 miles. The fish were strange to the crew, differing from any heretofore seen by them. They were from 12 to 16 inches long, some of them resembling rock cod.

The schooner Paul and Essie, of Swampscott, arrived home from Pensacola, Fla., where she had been engaged for four months in the red-snapper fishery, having stocked $4,400. She reported having found new and valuable fishing grounds off the Florida coast.

The southern mackerel fleet received daily additions to its numbers during the month, though fewer vessels have been engaged in the fishery this season than are ordinarily employed. The catch was far from satisfactory, owing largely to unfavorable and foggy weather during a large part of the time. Only a few of the vessels have caught any considerable quantity of fish, many of them having but a few barrels, and others have returned to refit without having caught a single fish. The total catch of mackerel by the southern fleet, from the beginning of the season up to the end of May, aggregated only about 5,000 barrels of salt mackerel, sea-packed, and about 8,000 barrels sold fresh. The mackerel are now well to the northward, and the body of fish seem to have disappeared for the time being. The mackerel vessels are widely scattered. A large part of the fleet is cruising between Fire Island and the Bay of Fundy, going as far to the eastward as George's Bank; quite a number remain in the vicinity of Block Island, and the remainder are cruising off the Nova Scotia shore. Large schools of pollock are reported off Cape Cod, and the fishermen claim that they have kept the mackerel away from the shores.

The catch of small herring in the vicinity of Eastport has been unusually light, and the sardine factories located there are reported to have packed only 2,000 cases up to the end of May, against 50,000 cases to the corresponding date in 1886.

The weir and trap fishing along other portions of the New England coast has fluctuated considerably. At times large catches have been made in certain localities, and again only small quantities have been secured, but enough bait has been taken to supply the fishing fleet at reasonable prices. Salt-clam bait, however, has proved very successful in the Western Bank cod fisheries, and the vessels from this port making the quickest trips and securing the largest fares have used salt clams exclusively. The schooner John W. Bray, which sailed from Gloucester on January 18 to engage in the Newfoundland frozen-herring trade, was detained by being frozen in at one of the harbors. She returned on May 12 with a cargo of 600 barrels pickled herring.

Fish landed at Gloucester by the fishing fleet in May, 1887.

Fishing grounds.	Fares.	Codfish.	Halibut.	Hake.	Cusk.	Pollock.	Haddock.	Mackerel.	Herring.
	No.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Bbls.*	*Bbls.*
By Gloucester vessels:									
Sable Island Bank	71	2,446,000	90,400	....	....	....	....	......	......
Grand Bank	20	70,000	726,000	....	....	....	....	......	......
George's Bank	115	2,129,000	210,700	....	2,000	....	....	......	......
Brown's Bank	3	31,000	16,400	....	1,000	....	....	......	......
German Bank	1	25,000	....	....	....	....	....	......	......
Cashe's Bank	1	15,000	....	3,000	2,000	....	....	......	......
Quereau Bank	3	18,000	66,000	....	....	....	....	......	......
Off Sable Island	3	....	78,000	....	....	....	....	......	......
Off Newfoundland	3	....	111,000	....	....	....	....	......	600
Off New England shore	121	838,100	....	....	....	....	32,505	......	......
Ipswich Bay	14	121,500	....	....	....	....	....	......	......
Off Cape Ann (small boats)	......	153,900	....	....	....	....	19,400	......	......
Off Cape Ann (traps)	......	....	....	....	....	....	....	......	298
Off New England shore	13	....	....	....	....	....	....	1,268	......
Total	368	5,847,500	1,298,500	3,000	5,000	....	51,905	1,268	898
By vessels belonging at other ports:*									
Jeffrey's Bank	18	383,000	....	53,000	19,000	....	37,000	......	......
George's Bank	3	41,000	....	....	....	....	....	......	......
Ipswich Bay	8	248,000	....	....	....	....	....	......	......
Sable Island Bank	2	170,000	4,000	....	....	....	....	......	......
Off New England shore	25	173,400	....	12,000	7,000	332,000	9,400	......	......
Cashe's Bank	6	192,000	....	18,000	28,000	....	8,000	......	......
Middle Bank	2	22,000	....	....	....	....	2,000	......	......
Nantucket Shoals	5	63,000	31,500	....	....	....	....	......	......
Off New England shore	1	....	....	....	....	....	....	110	......
Truro (weirs)	3	....	....	....	....	155,000	....	......	......
Total	73	1,292,400	35,500	83,000	54,000	487,000	56,400	110	......
Total for May, 1887	441	7,139,900	1,334,000	86,000	59,000	487,000	108,305	1,378	898
Total for May, 1886	235	4,565,000	1,088,990	5,400	....	414,000	31,000	480	......
Total for May, 1885	283	4,623,900	908,050	4,000	....	693,000	1,000	5,579	......

*The miscellaneous receipts from other ports during the month consisted of 1,000 barrels menhaden oil from Niantic, Conn

28.—THE FISHERIES OF GLOUCESTER, MASS., IN JUNE, 1887, WITH NOTES ON THOSE OF OTHER LOCALITIES.

By W. A. WILCOX.

The fisheries of Gloucester during the past month have not been as satisfactory as was anticipated. Vessels have sailed for the fishing grounds at frequent intervals, many of them starting on their first trips for the year, while others previously employed, after returning home with small fares, have refitted and again departed.

The receipts of cod at Gloucester during the month show a large increase over those of the corresponding month in 1886, but this increase is due to the large number of vessels from other ports landing their fares at Gloucester, and not to the greater abundance of fish. Codfish are reported to have been scarce on many of the distant fishing banks, and vessels have, as a rule, returned with only partial cargoes.

On George's the catch was larger than during the preceding month, but not equal to the light catch of June, 1886.

The schools of cod frequenting the shore waters off Cape Ann during the spring months have disappeared, and the catch in this locality has been light. Of the Gloucester vessels employed in the cod fisheries on the off-shore banks those using salt-clam bait exclusively have, as a rule, been more successful than those supplied with fresh bait. Many vessels depending entirely upon fresh bait have returned from Western Bank with an average of only 25,000 to 40,000 pounds. Among the arrivals of vessels fishing on Quereau, Grand, and Western Banks with salt clams are: Schooner M. H. Perkins, 140,000 pounds; schooner J. W. Collins, 140,000 pounds; schooner Druid, 135,000 pounds; schooner Flash, 90,000 pounds; and schooner Legal Tender, 60,000 pounds. Hake have been reported more abundant off the eastern portion of the New England coast, and on Cashe's and Jeffrey's Banks, during the month than during any preceding June for some years. A large percentage of the catch has been landed at Gloucester, and the receipts show a considerable increase.

Halibut have been scarce during the month, the Gloucester vessels arriving with small fares. The bulk of these fish are landed fresh and at once iced in boxes and distributed by rail to the trade. At times of oversupply the surplus is sent to the smoke-houses.

Pollock have been found in usual abundance off Cape Cod, being caught chiefly in traps and purse-seines.

The mackerel catch, although an improvement over that of 1886, has not thus far been satisfactory. Almost daily additions have been made to the mackerel fleet, and the fishing grounds about Block Island, off the New England and Nova Scotia shores, and in the Gulf of Saint Lawrence, have been well patrolled. At the close of the month the New England mackerel fleet numbered about 250 vessels, most of them cruising between Cape Cod and the Bay of Fundy, though about 30 sail had already entered the Gulf of Saint Lawrence. The first American seiner to enter the gulf during the present season was the schooner A. R. Crittenden, which passed through the Gut of Canso on June 15. The schooner Albert H. Harding followed soon after, but after a short cruise, during which not a single mackerel was seen, she returned, reaching Gloucester on June 27, and landed a cargo of 126 barrels, part of these being taken before entering the gulf and the remainder on her return passage after leaving same. Mackerel have schooled freely all along the New England coast, and occasional good catches have been made, but most of the schools have been small, containing only a few barrels. Much of the time the weather has been foggy, and seiners have been obliged to remain idle. The receipts have been light, and prices have advanced from $6 per barrel to $9 for sea-packed mackerel.

Herring of good size have been abundant along various portions of the shore between Cape Cod and Eastern Maine. The catch in weirs

and traps, and the occasional catches by the mackerel seiners, have been ample to supply the fishermen with bait at satisfactory prices. The small or sardine herring have been scarce most of the season in the vicinity of Eastport, and the canneries have done but little.

As far as known, the first swordfish of the season was caught off Block Island, and landed at New Bedford on June 11.

There has been a steady and good demand for all the varieties of salt fish, the receipts being taken at more satisfactory prices than those prevailing a year ago. No stock is accumulating. Prices for fresh sea fish have fluctuated, but the demand has been good, and cod and haddock have brought better prices than during June, 1866.

On June 30 there were 480 vessels, aggregating 30,848.02 tons, belonging in the district of Gloucester. Of these, 380 (over 20 tons each) aggregating 26,666.12 tons, and 49 (under 20 tons each) aggregating 556.07 tons, were employed in the fisheries. The fishing fleet of the district, when compared with that of June 30, 1886, shows a decrease of 8 vessels, and an increase of 164.23 tons; this increase in tonnage showing that larger-sized vessels have replaced those lost or sold.

Fish landed at Gloucester by the fishing fleet in June, 1887.

Fishing grounds.	Fares.	Mackerel.	Codfish.	Halibut.	Hake.	Cusk.	Pollock.	Haddock.	Herring.
By Gloucester vessels:	*No.*	*Bbls.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Bbls.*
George's Bank	137		2,351,000	175,600	2,000	3,000	3,000		
Western Bank	26		2,401,000	16,300					
Grand Bank	14		165,000	472,000					
Jeffrey's Bank	4		33,000		19,000			2,000	
Brown's Bank	2		73,000	1,800					
Cashe's Bank	3		55,000		35,000	5,000			
Quereau Bank	3		280,000	42,000					
Bay of Fundy	5		85,000	1,300	7,000		8,000		
La Have Bank	1			20,000					
Saint Paul Island	1			7,000					
Off Newfoundland	1			25,000					
Off New England shore	8		46,000		8,000			1,300	150
Off New England shore	44	3,356							
Off Nova Scotia Cape shore	20	3,855							
Off New England shore (small boats)			50,400		9,700			6,550	
Gloucester harbor (traps)									50
Off Magdalen Islands	2		75,000	44,500					
Total	271	7,211	5,614,400	805,500	80,700	8,000	11,000	9,850	200
By vessels belonging to other ports: *									
George's Bank	18		238,000	40,100					
Jeffrey's Bank	14		165,000		150,000	2,000		1,000	
Western Bank	8		855,000	1,800					
Quereau Bank	1			25,000					
Nova Scotia Cape shore	2		75,000						
Nantucket Shoals	1		4,000	7,000					
Cashe's Bank	20		450,000		239,000	7,000		4,000	
Off New England shore	22		133,000		72,000		422,500		80
Off New England shore	12	841							
Total	98	841	1,920,000	73,900	461,000	9,000	422,500	5,000	80
Total for June, 1887	369	8,052	7,534,400	879,400	541,700	17,000	433,500	14,850	280
Total for June, 1886	260	2,445	5,082,000	1,187,150	98,000	34,000	380,000		
Total for June, 1885	399	6,626	8,243,200	1,204,000	113,800	103,500	109,000		

---

* The miscellaneous receipts from other ports during the month consisted of 50 quintals cod, 50 quintals hake, 30 quintals cusk, and 150 quintals haddock, all from Maine.

Vol. VII, No. 6. Washington, D. C. Oct. 6, 1887.

29.—INJURIES TO THE FISHERIES IN THE BALTIC BY SEALS.[*]

By Mr. HINCKELMANN,

Royal Superintendent of Fisheries.

The constantly increasing number of seals on our Baltic coasts has become so serious a danger to our coast fisheries, that it appears high time to find ways and means to keep these injurious animals away from our shores. Ten or fifteen years ago, when our fishermen still underrated their destructiveness, and at best were amused to see one of them, it was hardly thought possible that these animals would one day endanger the fisheries on the coast of Sleswick-Holstein, where they formerly appeared only in small numbers and at places where there was not much chance of their injuring the fisheries.

Those fiords suffer most where cod fisheries are carried on with nets and bow-nets during the months of October, November, and December. The damage done to the fisheries by seals in Eckernförde and Neustadt alone is very considerable, as they frequently tear about a hundred nets in one day. Unfortunately the fishermen are very slow in making such cases public and bringing them to the knowledge of persons interested.

Hunting seals on our east coast has so far had little or no result. This sport offers too few attractions, for the seal when mortally wounded invariably sinks to the bottom, where, at least in deep water, it cannot be reached. It might be said that the purpose is fully answered if the seals are killed. But who will do this? There is no use in the fishermen carrying firearms, as they have often done, because they can engage in seal-hunting only in time left over from their proper employment. Moreover, firearms are rather in the way in a boat where fishing is being carried on, because there is constant danger that the crew will come in dangerous contact with these weapons. Seal-hunting from a boat is not very pleasant for sportsmen, because it can be done only in winter, and even then is very uncertain. An effective protection against seals, therefore, cannot be obtained in this way, and even the granting of rewards for killing them would not answer the purpose, because the huntsman can only in very rare cases prove that his shot has been successful, as the dead seal cannot be taken from the surface of the water, but sinks to the bottom.

---

[*] "*Schädigungen der Fischerei in der Ostsee durch Seehunde.*" From *Mittheilungen der Section des Deutschen Fischerei-Vereins für Küsten- und Hochsee-Fischerei*, Nos. 4 and 5, Berlin, April and May, 1886. Translated from the German by HERMAN JACOBSON.

Even if the fishermen should succeed in keeping these animals at bay with firearms, this would be possible only while they were working their nets in the fishing-grounds; but as soon as the boats were gone the seals would do as much injury as before. In favorable weather nets and bow-nets remain in the water from twenty-four to forty-eight hours before they are hauled in and the fish taken out, while in stormy weather four or five days may pass before a boat will venture out to haul in the nets. Such a period, when, owing to the power of the elements, fishing is at a standstill, is made good use of by the seals, so that after such pauses torn nets and half-devoured fish are found in the fishing-grounds instead of nets full of fish.

Such occurrences are exceedingly common during the season when the seals visit our coasts, and no one who has not seen the damage done to the fishing apparatus by the seals can have an adequate idea of the extent of this calamity, especially during last winter. Among the rest, a number of bow-nets for catching cod in the Neustadt Bay had been repeatedly torn to such a degree that it took weeks and a considerable outlay of money and labor to repair the damage.

In the neighborhood of the Schlei, where there were hundreds of flounder-nets, these were so badly injured by the seals that in a few weeks they had become useless. In the inner portion of the Eckernförde Bay nets and bow-nets (a particularly large number of the latter) had been injured by the seals to such a degree that when they were taken ashore to be dried they had many holes large enough for a man to creep through. In some cases the fishermen were compelled to stop fishing, although there were plenty of fish and the prices were high, simply because the seals had destroyed their apparatus. The cod fisheries by means of bow-nets have a still greater attraction for the seals than the fisheries with stationary nets, because in the meshes of the latter the fish hang quietly while they sport about freely in the bow-nets, and thereby attract the attention of their enemies.

Frequently seals will attack bow-nets filled with fish from the outside by tearing the sides and catching and devouring the fish which try to escape through the openings. But they also know how to find their way through the neck of the bow-net by advancing from one chamber to the other until they reach the fish in the last chamber. But as the last chamber of the bow-net has a narrower entrance than the first, it sometimes happens that the robber is caught and killed by the fishermen. On the whole, however, such cases are rare, because the bow-nets do not possess the necessary power of resistance required to hold the seals, which are armed with very sharp teeth.

It is not easy to answer the question as to how the evil can best be remedied, for even the use of poisoned fish as bait (apart from the danger connected with this method) would not be of any use, because the seals are very choice in the selection of their food, and would only take to the dead bait if there was absolutely no chance to get fresh fish, a case which will hardly ever occur in the open sea. It might be recommended to make an experiment with bow-nets made of galvanized-iron wire, painted brown, like the color of the bow-nets usually employed. The shape of these bow-nets should be that of the common bow-nets used for catching cod, but the entrances to the different chambers should be so arranged as to make it easy for the seals to slip in. Live fish—especially cod, of which the seals are very fond—might, if necessary, be put in these bow-nets when they are set; but there would probably be no lack of bait to attract the seals, as even in wire bow-nets plenty of fish are caught. Such an experiment, which should be made in places frequented by seals, would not involve any great expense, and would certainly be a step toward solving the question as to the best way of protecting the fishermen against the seals.

The chief cause why the seals infest our fishing-grounds in such large numbers must, however, be sought in the circumstance that in many places they enjoy full protection, so that sportsmen and visitors to watering-places may have a chance to follow the sport of seal-hunting. Near the Island of Rügen certain districts are rented out to seal-hunters, and the persons owning these districts take good care that the game shall not decrease, but rather increase, in number.

KIEL, GERMANY, *April*, 1886.

30.—REPORT ON THE SHAD WORK OF THE STEAMER FISH HAWK DURING THE SEASON OF 1887.

By Mate JAMES A. SMITH, U. S. N.

[Abstract.]

The shad work prosecuted by the steamer Fish Hawk during the season of 1887 covered the period from May 2 to 26, inclusive.

On May 2 the ship took a position on the east side of Chesapeake Bay and near the mouth of North East River, adjacent to the fishing shores and gillers in that vicinity, and began the work of hatching.

On May 3 arrangements were made with the proprietors of the fishing shores and the gillers to pay them for all impregnated shad eggs, and the spawn-takers began by tending Carpenter's Point, Red Bank, and Roche's fishing shores. As many gillers as could be conveniently were visited by the crew of the vessel.

On May 4 the ship was visited and inspected by the Assistant Commissioner, who gave instructions for the vessel to remain on this station until further orders, and the work of collecting, hatching, depositing, and transferring was carried on until the end of the season.

On May 6, all of the cones and hatching jars being full, 1,130,000 eggs were transferred to Battery Station. The next day, spawn being plentiful, 3,157,000 impregnated shad eggs were deposited.

On May 8, spawn still being collected in great numbers, the outside hatching cylinders were put in operation and 220,000 eggs were placed in each of the six cylinders; but, owing to the eggs having stood in buckets for some hours while the apparatus was being arranged, the number hatched out was very small, about 25 per cent.

On May 11 a shipment of 1,250,000 shad fry was made by the steamer Halcyon, to be deposited in the Sassafras River.

On May 14 2,000,000 good impregnated shad eggs were sent to Dr. E. G. Shortlidge, Wilmington, for the Delaware fish commission.

On May 15 a second trial was made with the cylinders, which resulted very satisfactorily. On the previous trial a great many young fish had broken their sacs by trying to get through the wire gauze. In this instance a layer of cheese-cloth was placed over the wire, thereby protecting the eggs and young fish. It being fine weather and the water smooth a percentage was hatched out equal to that secured by the cones.

On May 19 a second shipment of 1,054,000 shad fry was made by the steamer Halcyon, designed for the Chester River; but, owing to an accident to her machinery, the fish were deposited in Elk River and Bohemia Creek.

On May 23 it was found that the percentage of fish hatched from eggs received within the few preceding days had been very small owing to so many dead eggs being found in the jars and cones. Eggs which, when brought on board, seemed in prime condition and properly impregnated, died rapidly after being in the apparatus for thirty-six hours.

The work continued until May 26, when, in accordance with instructions, hatching operations were discontinued for the season, and all fish and eggs on hand were transferred to Battery Station.

TABLE I.—*Meteorological record made on board steamer Fish Hawk, Susquehanna River, from May 3 to 26, 1887.*

Date.	Air.		Surface.		Bottom.		Jars.		Direction of wind.	Force of wind.	Weather.
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.			
1887.	°	°	°	°	°	°	°	°			
May 3	80	60	60	58	60	60	61	59	Variable	0–3	Clear.
4	81	60	67	60	61	56	63	61	SE. and NNE	1–2	Partly cloudy.
5	77	58	64	62	63	62	64	63	S. and E	1–5	Clear.
6	78	54	67	63	65	62	67	64	S. and E	0–4	Partly cloudy.
7	76	65	66	64	66	64	68	65	N. and E	2–4	Squally and raining.
8	68	58	65	65	65	65	66	66	S. and E	2–5	Cloudy.
9	68	60	65	65	66	64	66	66	S. and E	3–4	Do.
10	72	59	66	65	65	65	66	65	S. and E	0–4	Foggy.
11	75	62	68	65	69	65	60	66	S. and W	0–3	Partly cloudy.
12	77	62	70	67	69	67	70	68	S. and W	0–3	Clear.
13	77	56	73	68	71	68	71	69	Variable	0–3	Do.
14	78	50	72	68	68	67	70	68	Variable	1–4	Do.
15	76	52	69	68	69	67	70	68	S. and W., S. and E	0–2	Do.
16	88	53	73	68	70	68	73	69	S. and W., S. and E	0–2	Do.
17	78	58	72	69	70	68	72	69	Variable	0–3	Do.
18	82	59	72	68	71	69	72	70	Variable	0–2	Do.
19	80	61	74	69	73	68	74	69	Variable	0–3	Do.
20	79	64	74	61	73	70	75	71	N. and E., S. and W	0–4	Partly cloudy.
21	84	68	75	73	75	72	76	73	S. and W	0–4	Do.
22	88	63	75	72	75	71	75	73	S. and W	1–4	Do.
23	78	64	75	74	74	73	76	74	Variable	3–5	Clear.
24	81	67	75	74	75	74	76	74	S. and E	3–7	Cloudy.
25	90	62	76	74	75	74	77	74	Variable	0–8	Squally.
26	82	63	75	74	74	73	75	75	Variable	0–9	Cloudy and raining.

State of water, clear.

TABLE II.—*Record of temperature observations made at Bull Mountain, on the steamer Fish Hawk, from May 3 to 26, 1887.*

Date.	Temperature of air.			Temperature of surface water.			Temperature of bottom.			Direction of wind.			Intensity of wind.			Condition of sky.			Condition of water.[*]	State of tide.		
	8 a. m.	12 m.	4 p. m.	8 a. m.	12 m.	4 p. m.	8 a. m.	12 m.	4 p. m.	8 a. m.	12 m.	4 p. m.	8 a. m.	12 m.	p. m.	8 a. m.	12 m.	4 p. m.		8 a. m.	12 m.	4 p. m.
1887.	°	°	°	°	°	°	°	°	°													
May 3[1]	65	60	62	58	60	60	58	59	59	NNE.	NNE.	NW.	3			Clear ...	Clear ...	Clear ...	Clear	Ebb ...	Flood ..	Flood.
4 ...	67	71	83	64	62	64	60	61	61	Calm.	Calm.	Calm.	0	0	0	Cloudy .	Partly cloudy.	Cloudy	......do	...do	Ebb ...	Do.
5	71	58	70	62	63	69	62	63	63	NE.	NE.	ESE.	5	3	3	.. do ...	.. do ...	.. do ..	..... do	...do ...	.. do	Do.
6	55	62	77	63	64	67	63	64	65	E.	ENE.	SE.	2	4	3	Foggy ..	.. do ...	.. do ...	..... do	.. do	...do ...	Do.
7	62	64	69	64	63	66	64	65	66	E.	ESE.	E. by N.	3	4	2	Cloudy	Cloudy	.. do ...	..... do	Flood..	...do....	Do.
8	58	64	67	65	65	65	65	65	65	E.	E.	E.	4	3	4	Foggy ..	...do ...	.. do ...	..... do	.. do	...do ...	Ebb.
9	59	60	70	65	65	65	65	65	65	ENE.	SE	SE.	2	3	3	...do ...	.. do ...	...do ...	......do	...do	...do ...	Do.
10[2]....	60	59	69	65	66	66	65	65	61	E.	SSE.	NW.	3	1	1	.. do ...	Clear ..	Partly cloudy.	Muddy	...do	Flood...	Do.
11[3]....	70	70	80	65	68	69	65	67	69	Calm.	Calm.	SW.	0	0	3	...do ...	...do ...	Clear.	..... do	...do	.. do ...	Do.
12[3]....	66	68	76	67	69	69	67	68	69	Calm.	NE.	SW.	0	3	3	Mist	...do	...do ...	Slightly muddy and clearing.	. do	.. do	Do.
13	66	56	76	68	69	72	68	69	69	NE.	ENE.	S.	2	1	1	Clear ...	...do ...	...do ...	......do	Ebb	...do	Do.
14 ..	66	54	67	69	68	70	68	68	68	ENE.	SE.	W.	2	3	1	...do ...	...do	.. do ..	Clear	...do	...do	Do.
15 ...	73	52	68	68	68	68	68	68	68	Calm.	ESE.	SW.	0	1	1	...do ...	.. do ...	.. do ...	..... do	...do	...do ...	Do.
16	64	52	62	68	68	68	68	68	68	SE	E.	SW.			1	...do ...	.. do ...	.. do ...	..... do	.. do	...do	Do.
17	64	61	77	69	70	72	68	69	71	NNW.	S.	SW.	2		1	...do ...	...do	...do ...	..... do	...do	Ebb ...	Flood.
18	61	64	78	70	69	72	69	69	71	ENE.	Calm.	Calm.	2	0	0	Cloudy	.. do ...	...do ...	..... do	...do	...do	Do.
● 19 ..	70	66	82	70	70	71	71	70	70	NE.	Calm.	SSW.	3	0	2	Clear ..	...do ...	...do ...	..... do	.. do	.. do ...	Do.
20	68	70	76	71	72	73	72	72	73	Calm.	SSW.	SW.	0	3	4	...do ...	.. do ...	...do ...	..... do	...do ...	...do ...	Do.
21	68	71	80	73	73	75	73	73	74	SSW.	S.	S.	3	4	4	Cloudy .	.. do ...	...do ...	..... do	...do ...	...do ...	Do.
22 ..	68	67	88	72	75	75	74	74	74	SW.	SE.	WNW.	2	4	2	.. do	.. do ...	.. do ...	..... do	.. do	.. do ...	Do.
23	73	70	78	74	74	75	74	74	74	SSE.	SSE.	SW.	3	4	5	Clear ...	Cloudy	...do ...	..... do	Flood ..	...do	Do.
24	72	68	76	74	74	75	74	75	75	SSE.	S.	S.	4	5	5	Cloudy	.. do ...	Cloudy	Muddy	...do	...do ...	Ebb.
25	70	61	84	74	74	76	74	74	75	NW.	S.	SW.	2	2	1	...do ...	Clear ..	.. do ...	Clear	...do ...	Flood..	Do.
26	66	.....	.....	74	..	...	74	....	....	WSW.	....	.....	2	...	...	...do	.....	....	Muddy	...do	....	....

---

[*] Depth of water at station 15 feet.

[1] Filled cones; temperature in same 63°, at bottom 59°.

[2] Rise in river above, water became muddy.

[3] Continuation of above, clearing slightly.

TABLE III.—*Record of shad-hatching operations conducted by the steamer Fish Hawk near the mouth of North East River, Maryland, from May 1 to 26, 1887.*

Date.	Fishery.	Fish.		Eggs obtained.	Eggs put in jars or cones.	Date of hatching.	Number hatched.	Fish or eggs disposed of.		Where transferred to or deposited.
		Male.	Female.					Number.	Date.	
1887.										
May 1	Ship's gill-net	1	1	60,000				60,000	May 2	Battery Station.
2	Ship's gill-net	1	1	62,000				62,000	May 2	Do.
3	Red Bank	5	5	241,000	2.30 a. m	May 5	176,000	176,000	May 5	North East River.
3	Gillers	2	2	30,000	2.30 a. m	May 5	25,000	25,000	May 5	Do.
3	Carpenter's Point	1	1	14,000	1.00 p. m	May 5	10,000	10,000	May 5	Do.
3	Red Bank	1	1	55,000	2.45 p. m	May 5	46,000	46,000	May 5	Do.
3	......do	5	5	210,000	6.15 p. m	May 6	187,000	187,000	May 5	Do.
3	Carpenter's Point	18	18	564,000	8.30 p. m	May 6	490,000	490,000	May 5	Do.
3	Red Bank	7	7	296,000	10 p. m	May 6	250,000	250,000	May 5	Do.
4	Gillers	3	3	102,000	3.45 a. m	May 6	90,000	90,000	May 5	Do.
4	......do	3	3	69,000	3.45 a. m	May 6	50,000	50,000	May 9	Do.
4	......do	6	6	291,000	3.30 a. m	May 6	175,000	175,000	May 9	Do.
4	Giller	2	2	58,000	7 30 a. m	May 6	50,000	50,000	May 9	Do.
4	Gillers	3	3	90,000	7.45 a. m	May 6	60,000	60,000	May 9	Do.
4	Carpenter's Point	10	10	420,000	6.45 p. m	May 6	375,000	375,000	May 9	Do.
4	Roche's Shore	7	7	161,000	8.20 p. m	May 7	125,000	125,000	May 10	Sassafras River.
4	Carpenter's Point	5	5	175,000	9 p. m	May 7	160,000	160,000	May 10	Do.
4	Gillers	7	7	252,000	9 p. m	May 7	200,000	200,000	May 10	Do.
4	......do	6	6	191,000	9 p. m	May 7	130,000	130,000	May 10	Do.
4	Red Bank	8	8	310,000	11 p. m	May 7	292,000	292,000	May 10	Do.
4	Gillers	7	7	220,000	12 m	May 7	138,000	138,000	May 10	Do.
5	......do	3	3	108,000	3.15 a. m		(*)			
5	......do	15	15	442,000	10 p. m	May 8	375,000	375,000	May 11	Do.
5	......do	15	15	616,000	10 p. m	May 8	553,000	553,000	May 11	Do.
5	......do	11	11	462,000	10 p. m	May 8	375,000	375,000	May 11	Do.
5	Carpenter's Point	22	22	672,000	10 p. m	May 8	615,000	615,000	May 11	North East River.
5	Gillers	1	1	56,000	10 p. m	May 8	45,000	45,000	May 11	Sassafras River.
5	......do	6	6	203,000	10 p. m	May 6		203,000	May 6	Battery Station.
5	......do	2	2	77,000	10 p. m			77,000	May 6	Do.
6	Red Bank and gillers	17	17	514,000	1.30 a. m			514,000	May 6	Do.
6	Gillers	15	15	336,000	1.30 a. m			336,000	May 6	Do.
6	......do	2	2	98,000	1.30 a. m	May 8	65,000	65,000	May 11	North East River.
6	......do	28	28	672,000	7 p. m			672,000	May 7	Do.
6	Carpenter's Point and gillers	19	19	868,000	9 p. m			868,000	May 7	Do.
6	Gillers	10	10	280,000	9.30 p. m			280,000	May 7	Do.
6	Roche's and gillers	11	11	476,000	10 p. m			476,000	May 7	Do.
6	Gillers	9	9	343,000	9.30 p. m			343,000	May 7	Do.
6	......do	9	9	420,000	10 p. m			420,000	May 7	Do.
7	......do	6	6	214,000	10 p. m	May 10	54,000	54,000	May 11	Do.

7	......do	6	6	262,000	10 p. m	May 10	65,000	65,000	May 11	Do.
7	......do	9	9	250,000	10 p m	May 10	65,000	65,000	May 11	Do.
7	......do	11	11	308,000	10 p. m	May 10	77,000	77,000	May	Do.
8	Giller	2	2	56,000	10 a. m	May	20,000	20,000	May	Do.
9	Gillers	2	2	80,000	8.30 p. m	May	50,000	50,000	May 15	Do.
9	Giller	2	2	75,000	8.30 p. m	May	50,000	50,000	May 15	Do.
9	Gillers	1	1	35,000	8.30 p. m	May 12	20,000	20,000	May 15	Do.
9	......do	2	2	50,000	8.30 p. m	May 12	30,000	30,000	May 15	Do.
9	......do	1	1	12,000	10 p. m	May 12	5,000	5,000	May 15	Do.
9	Red Bank and gillers	6	6	235,000	11 p. m	May 12	175,000	175,000	May 15	Do.
10	Gillers	2	2	65,000	2 a. m	May 12	35,000	35,000	May 15	Do.
1	Giller	4	4	121,000	2.30 a. m	May 12	70,000	70,000	May 15	Do.
10	......do	1	1	20,000	2.30 a. m	May 12	13,000	13,000	May 15	Do.
10	Gillers	6	6	110,000	9.15 p. m	May	55,000	55,000	May 15	Do.
10	......do	2	2	90,000	9.15 p. m	May 12	70,000	70,000	May	Do.
10	......do	2	2	45,000	9. p. m	May 12	34,000	34,000	May 16	Do.
10	......do	3	3	84,000	9. p. m	May 12	65,000	65,000	May 16	Do.
10	Giller	8	8	265,000	9. p m	May 12	215,000	215,000	May 16	North East River.
10	Gillers	5	5	198,000	9. p. m	May 12	175,000	175,000	May 16	Do.
10	.... do	1	1	28,000	9.15 p. m	May 12	20,000	20,000	May 16	Do.
10	Red Bank and gillers	9	9	280,000	9.15 p. m	May 13	245,000	245,000	May 16	Do.
11	Gillers	1	1	50,000	3 a. m	May 13	40,000	40,000	May 16	Do.
11	......do	1	1	36,000	3 a. m	May 13	23,000	23,000	May 16	Do.
11	......do	2	2	84,000	3 a. m	May 13	70,000	70,000	May 16	Do.
11	Giller	1	1	35,000	3 a. m	May 13	27,000	27,000	May 16	Do.
11	Gillers	9	9	238,000	9.30 p. m	May 13	175,000	175,000	May 16	Do.
11	......do	2	2	98,000	9.30 p. m	May 13	78,000	78,000	May 16	Do.
11	Carpenter's Point and gillers	11	11	406,000	9.30 p. m	May 13	320,000	320,000	May 16	Do.
11	Gillers	4	4	127,000	9.30 p. m	May 13	100,000	100,000	May 16	Do.
11	......do	3	3	33,000	9.30 p. m	May 13	24,000	24,000	May 16	Do.
11	Giller	12	12	285,000	9.30 p. m	May 13	220,000	220,000	May 16	Do.
11	Gillers	19	19	635,000	9.30 p. m	May 13	500,000	500,000	May 16	Do.
12	Red Bank and gillers	17	17	511,000	12.30 a. m	May 4	381,000	381,000	May 17	Do.
12	Gillers	10	10	476,000	10.30 p. m	May 15	419,000	419,000	May 18	Do.
12	...do	5	5	260,000	10.30 p. m	May 15	222,000	222,000	May 18	Do.
12	Carpenter's Point and gillers	19	19	651,000	10.30 p. m	May 15	455,000	455,000	May 18	Do.
12	......do	2	2	87,000	10.30 p. m	May 15	50,000	50,000	May 18	Do.
13	Red Bank and gillers	11	11	362,000	1.15 a. m	May 15	241,000	241,000	May 19	Chester River.
13	Carpenter's Point and gillers	12	12	406,000	11.30 p. m			406,000	May 14	Delaware Fish Commission.
13	Gillers	9	9	312,000	11.30 p. m			154,000	May 14	North East River.
13	......do	13	13	537,000	11.30 p. m			537,000	May 14	Delaware Fish Commission.
13	......do	16	16	553,000	11.30 p. m			553,000	May 14	Do.
14	......do	22	22	504,000	1.30 a. m			504,000	May 14	Do.
14	......do	1	1	31,000	11 p. m	May 16	20,000	20,000	May 19	Chester River.
14	......do	3	3	154,000	11 p. m	May 16	100,000	100,000	May 19	Do.
14	......do	7	7	242,000	11 p. m	May 16	125,000	125,000	May 19	Do.
14	......do	2	2	86,000	11 p. m	May 16	53,000	53,000	May 19	Do.
15	......do	16	16	553,000	12.50 a. m	May 17	350,000	350,000	May 19	Do.

*Jar broken and all lost.

TABLE III.—*Record of shad-hatching operations conducted by the steamer Fish Hawk, &c.*—Continued.

Date.	Fishery.	Fish.		Eggs obtained.	Eggs put in jars or cones.	Date of hatching.	Number hatched.	Fish or eggs disposed of.		Where transferred to or deposited.
		Male.	Female.					Number.	Date.	
1887.										
May 15	Gillers	9	9	280,000	12.50 a. m	May 17	155,000	155,000	May 19	Chester River
16	do	6	6	239,000	1.30 a. m	May 17	175,000	175,000	May 19	North East River.
16	do	7	7	225,000	1.30 a. m	May 17	135,000	135,000	May 19	Do.
16	do	3	3	119,000	1.30 a. m	May 18	105,000	105,000	May 21	Do.
16	do	18	18	466,000	1.30 a. m	May 18	300,000	300,000	May 21	Do.
16	do	7	7	224,000	1.30 a. m	May 18	180,000	180,000	May 21	Do.
16	do	2	2	89,000	10.30 p. m	May 18	80,000	80,000	May 21	Do.
16	Carpenter's Point	2	2	68,000	10.30 p. m	May 18	63,000	63,000	May 21	Do.
17	Gillers	1	1	35,000	1 a. m	May 18	30,000	30,000	May 21	Do.
17	do	2	2	50,000	1 a. m	May 20	45,000	45,000	May 21	Do.
17	do	1	1	18,000	1 a. m	May 20	15,000	15,000	May 21	Do.
17	do	3	3	66,000	1.30 a. m	May 20	60,000	60,000	May 21	Do.
17	do	13	13	320,000	2 a. m	May 20	303,000	303,000	May 21	Do.
17	do	5	5	144,000	9.45 p. m	May 20	134,000	134,000	May 22	Do.
17	do	18	18	438,000	11.45 p. m	May 20	403,000	403,000	May 22	Do.
18	do	3	3	105,000	2.30 a. m	May 20	75,000	75,000	May 22	Do.
18	do	1	1	29,000	2.30 a. m	May 20	19,000	19,000	May 22	Do.
18	do	6	6	224,000	9.30 p. m	May 20	175,000	145,000	May 22	Do.
18	do	1	1	35,000	9.30 p. m	May 20	20,000	15,000	May 22	Do.
18	do	5	5	166,000	9.30 p. m	May 20	126,000	105,000	May 22	Do.
18	do	3	3	123,000	9.30 p. m	May 20	40,000	40,000	May 22	Do.
18	do	16	16	391,000	11.45 p. m	May 21	285,000	285,000	May 23	Do.
19	do	1	1	14,000	3 a. m	May 21	10,000	10,000	May 23	Do.
19	Giller	1	1	18,000	8 a. m	May 21	15,000	15,000	May 23	Do.
19	do	1	1	52,000	10 p. m	May 21	34,000	34,000	May 23	Do.
19	J. E. Ford	12	12	371,000	10 p. m	May 21	175,000	175,000	May 23	Do.
19	Gillers	9	9	231,000	10 p. m	May 21	120,000	120,000	May 23	Do.
19	do	9	9	266,000	10 p. m	May 21	120,000	120,000	May 23	Do.
19	do	8	8	208,000	10 p. m	May 21	100,000	100,000	May 23	Do.
20	do	14	14	470,000	12.30 a. m	May 22	231,000	231,000	May 24	Do
20	do	1	1	45,000	9.30 p. m	May 22	30,000	30,000	May 24	Do.
20	do	6	6	200,000	9.30 p. m	May 22	121,000	121,000	May 24	Do.
20	do	2	2	67,000	10 p. m	May 22	50,000	50,000	May 24	Do.
20	do	5	5	178,000	10 p. m	May 22	136,000	136,000	May 24	Do.
20	do	7	7	240,000	10 p. m	May 23	200,000	200,000	May 24	Do.
20	do	1	1	35,000	9 p. m	May 23	20,000	20,000	May 24	Do.
20	do	24	24	763,000	1.50 p. m	May 23	408,000	408,000	May 24	Do.
21	do	3	3	95,000	6.30 p. m	May 23	30,000	30,000	May 25	Do.
21	do	1	1	28,000	10.30 p. m	May 23	10,000	10,000	May 25	Do.

21	......do	5	5	124, 000	10.30 p. m	May 23	40, 000	40, 000	May 25	Do.
21	......do	3	3	94, 000	10.30 p. m	May 23	30, 000	30, 000	May 25	Do.
21	......do	5	5	112, 000	10.30 p. m	May 23	35, 000	35, 000	May 25	Do.
21	......do	6	6	147, 000	11.45 p. m	May 23	57, 000	57, 000	May 25	Do.
21	Giller	1	1	35, 000	11.45 p. m	May 23	15, 000	15, 000	May 25	Do.
21	......do	3	3	68, 000	11.45 p. m	May 23	25, 000	25, 000	May 25	Do.
21	Gillers	3	3	81, 000	11.45 p. m	....	(*)	....	....	....
22	......do	6	6	70, 000	11.20 p. m	May 24	45, 000	45, 000	May 25	North East River.
22	......do	8	8	116, 000	11.20 p. m	May 24	70, 000	70, 000	May 25	Do.
22	......do	3	3	114, 000	11.20 p. m	May 24	60, 000	60, 000	May 25	Do.
23	......do	1	1	15, 000	11 p. m	May 25	15, 000	15, 000	May 26	Battery Station.
23	......do	1	1	9, 000	11 p. m	May 25	9, 000	9, 000	May 26	Do.
25	......do	3	3	54, 000	10 p. m	....	....	54, 000	May 26	Do.
	Total	909	909	29, 334, 000	....	....	15, 801, 000	22, 264, 000		

---

* Died; improper impregnation.

U. S. FISH COMMISSION STEAMER FISH HAWK,

Baltimore, Md., July 9, 1887.

31.—EXPERIMENTAL HYGIENE—OBSERVATIONS ON THE RED FLESH OF THE CODFISH.*

By Dr. ALEXANDRE LAYET.

[Report made to the Mayor of Bordeaux.]

Fish-dealers acknowledge that the redness in codfish has only recently made its appearance, and attribute it to the use of Mediterranean salt. This leads us to a consideration of the methods of preserving fish by salting it, and of the influence which the degree of salting may have on the development of parasitic germs in albuminous substances. Practical observations have revealed certain facts which appear to show the influence of the method of salting on the appearance of parasitic germs in such substances as the red flesh of the codfish and the Norwegian sardines; and facts brought out by actual experiments have proved that sea-salt has an influence on the development of such germs. Miquel has shown conclusively that in proportion to the quantity of salt used in preserving articles of food, parasites appear in greater or less quantity; a certain proportion of salt favors their evolution, whilst another proportion entirely prevents it.

On the other hand, facts gathered from actual observation relating exclusively to the sanitary side of the question, show that there have been actual cases of poisoning from codfish which had become changed without turning red or by turning red. The cases of poisoning by changed codfish which had not turned red are among the earliest known and the most common; whilst the cases where the codfish had turned red are very rare. The first cases of this are those reported by Dr. Bertherand, of Algiers, in January, 1884. The hygienic commission of Algiers had recognized the necessity of withdrawing the red codfish from the market. This is the only precedent which can be quoted.

A second case produced by red codfish is that reported by Mr. Berenger Féraud, where 200 of the 380 men composing the crew of the man-of-war Vengeance, at Lorient, became more or less seriously indisposed after having eaten codfish from the naval provision bureau (October, 1884). This fact has probably drawn special attention to the red codfish and has caused the recent prohibitory measure.

The cases of indisposition caused by partaking of spoiled codfish resemble in every particular those produced by using animal food which has undergone a certain degree of decomposition. We invariably find the same series of gastro-intestinal, cholera like symptoms, accompanied by more or less clearly defined disturbances of the nervous system. It is generally agreed that these symptoms are caused by the formation in articles of food of a poisonous alkaloid. Brieger (1884–1885), who has made experimental researches regarding such alkaloids (*ptomaïne*) developed in spoiled codfish, has discovered in such fish, besides the alkaloids generally found in decayed animal articles of food, a particular kind of *ptomaïne*, the *gadinine*. Other authors, among them Anrep and Bocklisch (1885), have also made an investigation of the *ptomaïne* found in the decayed flesh of fish.

---

* "*Hygiène Expérimentale. Note sur le rouge de la Morue.*" From *Revue Sanitaire de Bordeaux et de la Province*, April 25, 1886. Translated by HERMAN JACOBSON.

As regards the red codfish, it should be stated that the reports on cases of indisposition caused by red codfish also make mention of a putrid odor of the flesh, of its softening, and its tendency to crumble to pieces. The red codfish which produced these cases of indisposition was certainly spoiled, the symptoms observed being those produced by animal articles of food which to a certain degree had become decomposed; but the redness has been given as the cause only in as far as one has been led to consider it as favoring a change of the flesh of the codfish. It may, however, be asked if this redness does not also show itself in codfish whose flesh is sound; and, in our opinion, this is generally the case. The redness is really an external phenomenon. Among a large number of codfish in which redness had shown itself there were found, just as among codfish which showed no redness, sound, comparatively sound, and spoiled fish.

These are the first results of investigations made by us at the laboratory of hygiene of the Medical School, assisted by Mr. Artigalas, professor at this school, and Mr. G. Ferré, superintendent of histological experiments.

This first report is confined to the nature of the red color of the codfish, to the manner in which it spreads on the surface and inside the tissues, and to the relations which may exist between the presence of this red color in the interstices between the bundles of muscles and the change or decay observed in these bundles.

The only observation known to science as regards the nature of the red color in the codfish was made by Mr. Mégnin, a distinguished authority on micrography, to whom Mr. Bertheraud had forwarded samples of the red codfish which had caused the cases of indisposition at Algiers in 1884. Mr. Mégnin considers the redness as a fungus growth of the family of the "*Protomycètes*," and of the variety "*Coniothecium*." The characteristics attributed by him to these minute organisms are the following: "Round spores of a very pale rose color, with granular contents, and a small kernel measuring from six to ten thousandths of a millimeter in diameter; the largest of these spores are divided into two or four equal parts, which become new spores; a short mycelium, hardly discernible, in most of these diminutive spores."

We should add, from a practical point of view, that neither Mr. Mégnin nor the other persons who have studied the sanitary side of this question have made practical experiments by making animals eat of red codfish. We must say the same as regards ourselves.

Mr. Berenger-Féraud, in his very remarkable clinical examination of the cases of indisposition observed at Lorient among the crew of the Vengeance, has not made any personal investigation of the nature of the red codfish. He attributes it, according, as he states, to the few authors who have occupied themselves with this question, to the presence of a small fungus, the *Penicillium roseum*. But, to begin with, what is this *Penicillium roseum*? In the investigations made by us at the laboratory of hygiene at the Medical School of Bordeaux we made strenuous efforts to throw aside all preconceived notions and to describe only what we had occasion to personally observe.

The question before us was really not so much to specify the nature of the small organisms which constitute the redness of the codfish as to determine the conditions of their presence in the different samples of codfish submitted to us for examination. In making a general examination of the redness in articles of food, we find that the small organisms containing erythrogen found in articles of food occur in greatly varying forms, from the *Micrococcus prodigiosus* common in albuminous and amylaceous articles of food, to the numerous *Bacilles erystrospores* found in decaying albuminous substances, and from the isolated micrococcus to the composite forms, composed of two, three, or four elements, like the *Micrococcus aurantius*, or the gelatinous aggregations composed of numerous elements, like the *Bacterium rubescens*.

The red on the surface of the codfish shows itself in the shape of granular matter, developing in moist streaks in the folds and furrows or mingling with the outer layer of salt, as may be observed especially in the kind of codfish called "green codfish." In laying bare the lower layers one finds absolutely no redness in the flesh.

On the dry codfish, that which belongs to the large red kind, for instance, the colored matter shows itself on the surface in diffused forms of a whitish and rosy appearance; and when the outer layer has been removed, it is found again in the form of an infiltration in the interstices between the bundles of muscles and having a bright blood-red color. In cutting into the codfish we find these red infiltrations in all the fissures, depressions, and interstices, more particularly in the interosseous and latero-vertebral furrows. It is this condition of being almost entirely penetrated by the red color which gives to the dry codfish, when held before a bright light, a very marked rosy transparency.

In examining the red substance under the microscope we find, after it has been dissolved in water or glycerine, that it is composed of (1) crystals of sea-salt; (2) lanceolate lamellæ; (3) a granular substance; (4) muscular elements; (5) special elements, which we shall describe below.

(1) The crystals of sea-salt do not show anything of special interest; by the side of them we find some rusty fragments which appear to belong to the particles of iron sometimes found among sea-salt.

(2) The lanceolate lamellæ originate in cavities found in the layer of codfish immediately underneath the red part. These cavities where the lamellæ develop are formed at the expense of the muscular tissue. The lamellæ are colored by carmine; they are the result of a transformation of the muscle. They are certainly not composed of a fatty substance, for they do not turn black by an application of osmic acid, and even in muscles which were cut and to which this acid was applied, the cavities inclosing the lamellæ remained light whilst the muscular substance of the codfish turned completely black. This coloring of the muscle of the codfish is caused by its being impregnated with an oily substance.

These cavities, when beginning to form, are entirely filled with lamellæ; later when they increase in size they begin to open out in a level with the red which enters them, and their center becomes granular. By the side of these cavities others are found which are empty and which look as if they had been cut with a sharp instrument. They are scattered throughout the entire tissue of the codfish, both in that portion which comes in contact with the red and in that which is next to the skin.

(3) The granular substance appears to be composed of detritus mixed with elements in which three or more form a sort of an organism, and with the special elements which we are going to describe. The color of this substance is light yellowish.

(4) The muscular elements terminate in irregular borders of a granular nature, which appear corroded. They are probably the result of the breaking of the muscular tissue consequent upon the growth of the cavities filled with lamellæ and a granular substance. These muscular elements have preserved their striation. They float in the liquid produced by decomposition, and probably aid in forming the granular substance described above.

(5) We now come to the description of the special elements which enter into the composition of the red, properly so called. These elements approach, as to form, the elements called sarcodes, found in decaying substances but also in sound substances. They represent quarters of a sphere united by a common diameter. There are some in which the segmentation of one-half of the sphere has not taken place, and which therefore show the form of two quarters of a sphere and a half-sphere joined on the flat side, whilst others are two half-spheres, whose segmentation is not complete. These elements are refringent, and appear at first sight to be homogeneous. When dissolved, however, or rather when brought into contact with a solution of osmic acid (1 per cent. of acid), each element assumes a brown color, and spherical granulations make their appearance and a double outline.

Taken separately, each of these elements is transparent and colorless, but when grouped in masses forming several layers it can easily be seen that the center of the mass is of a rosy color, the density of the mass increasing from the periphery to the center. The color would, therefore, appear to be due to the greater or less quantity of these elements in the mass.

But we deemed it proper to ask whether the mass of granulations properly so called did not aid in producing the red color. One of our number thought that the red was formed exclusively by sarcoid elements. He ascertained in fact that there was no red granular mass without sarcoid elements, while a mass composed solely of these elements was invariably found to be more or less red. This is, however, still a subject of controversy between us, and we therefore reserve our final opinion on this point.

From the preceding facts, and following the micrographic examination, we have arrived at the following conclusions:

(1) There are on the surface of the codfish, tainted with redness in the interstices between the superficial muscular bundles, special organisms of a vegetable nature which constitute the coloring elements.

(2) These elements are found in masses together with a granular substance composed of single or double grains, zooids and detritus.

(3) These colored masses become denser when in close proximity to the salt crystals, appear together with them in the interstices between the muscular bundles, and fill the small cavities which we have described when these open on a level with them.

An important point to be elucidated was whether in the sound codfish, without red, the cavities above described could be found. It was easy to ascertain this. Cuts made in a codfish of this kind revealed the cavities formed of ray-like lamellæ, and more or less filled with detritus. They are found, as in the red codfish, in the first ventral muscular layer in the shape of grains making a screeching noise under the glass plate when the preparation is pressed.

This kind of corrosion of the muscular fibers must therefore be attributed to an entirely different cause than the presence of the red. It is probably a normal production in the codfish caused by the salting process.

In the codfish tainted by the red no other change is observed in the muscular tissue except this formation of small cavities which are found in the salt, the white and sound codfish, only the red finally penetrates the fish, continues to develop, and gains in strength.

To sum up, it appears from this first series of experiments made by us that the red in itself cannot be considered as the cause of indisposition produced by spoiled codfish, and that the poisonous character of the codfish depends entirely on the state of its putrid decomposition.

In future reports we propose to give the result of our researches regarding the experimental culture of the diminutive organism which constitutes the red in the codfish, regarding its transmission and its development in sound and decayed codfish, and regarding the various conditions (salting, packing, storing) which, from a practical point of view, may serve to protect the codfish against the development of the red.[*]

We cannot at present dwell any longer on this side of the question, for, as we have already stated, we shall in a future report give the results of our investigations regarding the different methods of salting, the examination of the different kinds of salt used, the packing and storing of the codfish. We shall merely state regarding the nature of the small organism composing the red in the codfish that we have never yet found the slightest trace of a mycelium. We therefore do not believe that it is a fungus, not even one of the family of the *Discomycetes*, like the *Protomyces* for instance. It is doubtless an alga, but it is an open question whether it is a *Beggiatoa* of the family of the *Nostocaceæ*, like the *Clathrocystis*, which Mr. Farlow considers as the cause of the red in the codfish.

BORDEAUX, FRANCE, *March* 24, 1886.

32.—REPORT OF OPERATIONS AT THE SHAD-HATCHING STATION ON BATTERY ISLAND, NEAR HAVRE DE GRACE, MD., DURING THE SEASON OF 1887.

By **W. de C. RAVENEL**,

Superintendent of Battery Station.

Active operations in the production of young shad were very much delayed by strong freshets in the Susquehanna River and exceedingly cold weather, but preparations had been completed for the work some time before eggs could be obtained. It was not until April 26 that the first spawn was taken, and this was of inferior quality on account of low temperature, &c. It will be proper to say, therefore, that the season opened on May 1.

The seine operated in previous years was not used this season, as its results were not in proportion to the expenditures connected there-with and as much dissatisfaction was expressed at its use by the neighboring fishermen.

---

[*] Our attention has been called to an article published in the Imparcial, of Madrid, of the 20th March, in which it is stated that some years ago, in 1878, a red coloring of the green and dry codfish was, during summer, observed at Gloucester and at other places in the United States. The Fish Commission requested Prof. W. G. Farlow to inquire into the causes of this coloring. Professor Farlow found (Fish Commission Report, 1878, page 969) that it is due to the presence of *Clathrocystis roseo-persicina*. "After having observed," the writer of the article in the Imparcial goes on to say, "that this hurtful vegetable growth was found on all the walls and boards of the salteries and on all the wooden implements used in them, it was considered safe to assume that only the salt could be the means of its transmission." The Cadiz salts, which have a light rose-color, were examined, and after this examination Professor Farlow arrived at this conclusion: "That the imported Cadiz salt is impregnated with a large quantity of *Clathrocystis*, and that this plant develops on the codfish when the temperature is favorable." The Imparcial becomes alarmed at this statement, and fears that the Spanish salts, which in America are all known by the name of Cadiz salts, may lose their reputation.

On account of the limited means at our disposal it was impossible to engage the force adequate for the work. Hence the steamers Fish Hawk and Halcyon were sent to the station to assist in hatching operations. These vessels were utilized in securing spawn from the gill-nets on the eastern side of the Bay.

The Fish Hawk operated in this manner until May 2, when, finding the prospects so favorable, she proceeded to Bull Mountain and anchored, where she continued independent operations until the work ceased. During the season this vessel transferred to Battery Station 1,330,000 shad eggs.

The Halcyon made daily trips to the eastward, leaving the station in the evening and returning early the next morning. There were 8,402,000 eggs transferred to the station by this vessel. The Halcyon was also utilized in the shipment of shad fry to the Chester, Elk, and Sassafras Rivers. An accident to her wheel, which necessitated a trip to Baltimore for repairs, suspended her operations for a few days, but on her return to the station the daily trips for spawn and the shipment of shad fry were resumed and continued until May 21, when the steamer was assigned to other duty. During the season the Halcyon deposited about 3,000,000 young shad in the rivers named.

Marketable shad were very abundant this spring, the run being greater than has been known for many years. One fishing float secured as many as 47,000 shad.

Only four spawn takers and two men for handling the stationary gill-net for catching ripe male shad had been engaged, and this small force was totally inadequate for the work. The number recommended was forty, but lack of funds prevented their employment. In order to supply the deficiency, a detail of twenty-one men from the steamer Albatross, accompanied by an officer, was sent to the station. This action was made possible by the laying up of that vessel to receive new boilers. The men, however, did not arrive at the station until May 10. Had they reported for duty ten days earlier, the result of the season's work would have been much larger, as they proved apt and soon learned to take spawn successfully.

The abundance of ripe shad is illustrated by the fact that on one night (May 7) five of the station boats secured four millions of eggs, one of them obtaining as many as 1,300,000. All of the fishermen were as successful as the ones whose fish were overhauled, but it was impossible for the few men to attend them in time to get the spawn from the fish while they were alive—and this was the case night after night.

The hatching operations were under the charge of Mr. Wm. P. Sauerhoff, assisted by three trained experts, under whose careful handling eggs usually hatched successfully. Upon three occasions very se-

Vol. VII, No. 7. Washington, D. C. Oct. 6, 1887.

vere losses of eggs were suffered, 1,500,000 being lost on one occasion, and 500,000 on two others. The eggs of the first lot were taken by our most skillful spawn-takers, and appeared sound and healthy when placed in the hatching cones, but soon died. No cause can be ascribed for this loss. The second and third lots were lost from defective arrangements of the water-pipe in the hatching house.

As will be seen by reference to the accompanying tables, the station received during the season 60,569,000 eggs, from which 42,712,000 shad fry were hatched, and 918,000 eggs were transferred to car No. 3. Of those hatched, 11,850,000 were placed in the waters around the station and 29,882,000 were shipped to other points. The table of distribution will give in detail the disposition of the shad fry.

It is evident that the work of the station is limited only by the means at its disposal, and that it would be easy to obtain 125,000,000 eggs. This season's work was accomplished without visiting any of the fishing floats or shores and without covering the ground occupied by the Fish Hawk.

BATTERY STATION, *June* 5, 1887.

TABLE I.—*Statement of shipments of shad fry made from Battery Station, Havre de Grace, Md., in May and June,* 1887.

State.	Place of deposit.	Stream.	Date.	Number sent.
Delaware	Wilmington	Brandywine River	May 10	2,200,000
	Seaford	Nanticoke River	May 11	2,200,000
	Middletown	Creeks	May 19	150,000
	Clayton and Morton	do	do	150,000
	Dover and Felton	do	do	150,000
	Milford and Ellendale	do	do	150,000
	Millsborough	Indian River	do	400,000
	Wilmington	Brandywine River	May 21	1,924,000
	Seaford	Nanticoke River	May 28	1,400,000
Georgia	Cartersville	Etowah River	June 5	450,000
	Resaca	Oostenaula River	do	1,050,000
Kentucky	Louisville	Ohio River	May 30	1,615,000
Maryland	Elkton	Elk River	do	2,600,000
	Bush River	Bush River	do	960,000
	Gunpowder	Gunpowder River	do	745,000
	Relay Station	Patapsco River	May 25	300,000
	Chestertown	Chester River	May 19	400,000
	Hillsborough	Tuckahoe River	do	3,400,000
	North East	North East River	do	960,000
	Port Deposit	Susquehanna River	do	920,000
	Battery Station	do	do	13,903,000
	Whaleysville	Pocomoke River	May 16	1,800,000
Massachusetts	Dighton	Taunton River	May 24	1,500,000
Pennsylvania	Harrisburg	Susquehanna River	May 20	1,500,000
	Sundry places	do	do	1,820,000
Total				42,650,000

A more detailed account of these shipments, the losses in transit, &c., will be found in the Report of Shad Distribution for 1887, by Marshall McDonald.

TABLE II.—*Record of meteorological observations made at Battery Station, Maryland, from April 27 to June 3, 1887, by William P. Sauerhoff.*

Date.	Temperature of air.			Temperature of surface water.			Direction of wind.			Intensity of wind.			Condition of sky.			Condition of water.	State of tide.			Weather.
	6 a. m.	12 m.	6 p. m.	6 a. m.	12 m.	6 p. m.	6 a. m.	12 m.	6 p. m.	6 a. m.	12 m.	6 p. m.	6 a. m.	12 m.	6 p. m.		6 a. m.	12 m.	6 p. m.	
1887.	°	°	°	°	°	°														
Apr. 27	50	58	57	51	53	53	S.	S.	SW.	Light	Light	Light	Cloudy	Hazy	Hazy	Clear	Ebb	Flood	Ebb	
28	54	55	56	53	54	55	NE.	S.	SE.	...do	Fresh	Fresh	...do	Cloudy	Cloudy	Muddy	...do	...do	...do	Rain.[1]
29	55	52	51	54	53	52	SW.	NW.	W.	Fresh	Strong	...do	...do	...do	...do	...do	...do	...do	...do	Do.[2]
30	50	53	56	51	51	52	NW.	NW.	NW.	...do	...do	...do	Hazy	Hazy	Clear	...do	...do	...do	...do	
May 1	50	61	60	50½	54	55	W.	S.	SW.	Light	Fresh	Light	Clear	Clear	Cloudy	Clear	...do	...do	...do	
2	58	64	60	53	55	59	NE.	NE.	SW.	...do	Light	...do	...do	Cloudy	Clear	...do	...do	...do	Flood	
3	61	69	70	56	59½	61	NE.	S.	......	...do	...do	Calm	...do	Clear	...do	...do	Flood	Ebb	High	
4	65	69	72	60	62	64	SE.	SE.	......	Calm	Calm	...do	...do	...do	...do	...do	...do	...do	Flood	
5	66	70	68	62	65	65	N.	N.	E.	Light	Light	Light	...do	...do	...do	...do	...do	...do	...do	
6	62	80	70	61	64	68	NE.	S.	SE.	...do	...do	...do	Cloudy	...do	Cloudy	...do	...do	...do	...do	Do.[3]
7	65	76	68	64	65½	65½	NE.	SE.	SE.	...do	...do	...do	...do	Cloudy	...do	...do	...do	...do	...do	
8	62	62	64	64	63½	65	NE.	E.	E.	Fresh	Fresh	Fresh	...do	...do	...do	Muddy	...do	...do	...do	
9	60	65	65	63½	64	64	NE.	NE.	SE.	...do	...do	Light	...do	...do	...do	...do	...do	...do	...do	Do.[4]
10	61	64½	65	64	65	65	NE.	NW.	......	Light	Light	Calm	...do	Clear	Clear	...do	...do	Flood	Ebb	
11	64	71	71	64	67	68	SW.	S.	SW.	Calm	...do	Light	Clear	...do	...do	...do	Ebb	...do	...do	
12	70	72	72	65	66	68	S.	S.	SW.	Light	...do	...do	...do	...do	...do	...do	...do	...do	...do	
13	63½	65	65	64½	65½	68	NE.	SE.	S.	Fresh	...do	...do	Hazy	...do	...do	...do	...do	...do	...do	
14	67	75	69	65	69	70	N.	.....	SE.	Light	Calm	Fresh	Clear	...do	Cloudy	...do	...do	...do	...do	
15	66	72	73	65½	67	70	S.	SE.	SE.	...do	Light	...do	...do	Cloudy	Clear	...do	...do	...do	...do	
16	67	71	71	65	66½	69	S.	S.	SE.	...do	...do	...do	Cloudy	...do	Cloudy	Clear	...do	...do	...do	
17	67	74	69	65	68	70	.....	S.	SW.	Calm	...do	Light	Clear	Clear	Clear	...do	...do	...do	...do	
18	65	76	76	68	69	70	SE.	S.	SE.	Light	...do	...do	Cloudy	...do	...do	...do	Flood	Ebb	Flood	Do.[5]
19	64	78	74	67	71	72½	......	SE.	......	Calm	...do	Calm	Clear	...do	...do	...do	...do	...do	...do	
20	68	79	75	70	72½	74	S.	S.	SW.	Light	...do	Light	...do	...do	...do	...do	...do	...do	...do	
21	69	75	76	73	74	74	SW.	SW.	SW.	...do	...do	...do	Cloudy	...do	...do	...do	...do	...do	...do	
22	70	76	77	72½	74	74	SE.	SE.	SW.	...do	...do	...do	Clear	Hazy	...do	...do	...do	...do	...do	
23	68	75	74	73	74	76	S.	SW.	W.	...do	...do	Fresh	...do	Clear	...do	...do	...do	...do	...do	
24	73	75	72	73	75	76	S.	S.	S.	...do	Fresh	...do	Cloudy	Cloudy	...do	...do	...do	...do	...do	Do.[6]
25	60	77	68	72	74	75	N.	S.	SW.	...do	...do	...do	Clear	Clear	Cloudy	...do	Ebb	Flood	Ebb	Do.[7]
26	66½	77	67	73	77	76	NE.	NW.	NW.	...do	Light	...do	Cloudy	...do	...do	...do	...do	...do	...do	Do.[8]
27	61	63½	63	71	71	71	NW.	NW.	NW.	...do	Fresh	...do	Clear	...do	...do	...do	...do	...do	...do	Do.[9]
28	56	63	63	67	67	66	NW.	NW.	N.	Fresh	...do	...do	Cloudy	Cloudy	...do	Muddy	...do	...do	...do	Do.[10]
29	63	63	64	65	67	67½	NE.	NE.	S.	Light	Light	Light	...do	Clear	...do	...do	...do	...do	...do	
30	63	65	62	66	66½	68	S.	S.	SE.	...do	...do	Strong	Hazy	...do	Clear	...do	...do	...do	...do	
31	64	64	62	65	65½	65	SE.	SE.	SE.	Fresh	Fresh	Fresh	Cloudy	Cloudy	Cloudy	...do	...do	...do	...do	Do.[11]

June	1	64	67	73	62½	64	66	SE.	SW.	SW.	...do	Light	Light	..do	Clear	...do	.do	High	Ebb	..do	Do.[12]
	2	68	65	72	66	66	69	S.	SW.	SW.	...do	Fresh	Strong	...do	...do	Clear	...do	Flood	...do	Flood	
	3	64	69	74	66	67	68	NW.	S.	SW.	Light	Light	Fresh	...do	Cloudy	Cloudy	...do	...do	...do	...do	

[1] From 3 p. m. to 6 p. m.

[2] Squally all day.

[3] Began at 12 p. m. and stopped at 8 a. m. of 7th.

[4] All day.

[5] From 7 a. m. to 8.30 a. m.

[6] Squall 2.30 p. m.

[7] Squall 5.15 p. m.

[8] Squall 6 p. m.

[9] At 6 p. m.

[10] At 2 p. m.

[11] Storm all day.

[12] From 6.30 a. m. to 9.30 a. m.

TABLE III.—*Record of the shad-hatching operations conducted at Battery Station, Maryland, from April 26 to June 3, 1887, by William de C. Ravenel.*

Date.		Eggs obtained.	Loss.		Fish hatched.	Fish deposited in local waters.	Fish deposited in other waters.
Day of week.	Day of month.		Eggs.	Fish.			
Tuesday	Apr. 26	241,000					
Wednesday	Apr. 27	336,000	150,000				
Thursday	Apr. 28						
Friday	Apr. 29						
Saturday	Apr. 30	660,000					
Sunday	May 1	792,000					
Monday	May 2	2,453,000					
Tuesday	May 3	1,531,000	150,000				
Wednesday	May 4	2,098,000	500,000				
Thursday	May 5	3,763,000					
Friday	May 6	4,095,000			229,000	229,000	
Saturday	May 7	4,302,000	500,000				
Sunday	May 8	821,000					
Monday	May 9	2,362,000	1,500,000		1,078,000	500,000	
Tuesday	May 10	955,000		50,000	2,568,000		2,500,000
Wednesday	May 11	3,876,000			2,000,000		2,500,000
Thursday	May 12	2,115,000		50,000	2,717,000		2,360,000
Friday	May 13	2,552,000			2,648,000	420,000	2,160,000
Saturday	May 14	2,883,000		28,000	2,000,000		2,360,000
Sunday	May 15	2,302,000			927,000		2,160,000
Monday	May 16	1,882,000			1,538,000		560,000
Tuesday	May 17	2,743,000			2,497,000		1,973,000
Wednesday	May 18	3,145,000			1,034,000		300,000
Thursday	May 19	2,278,000		500,000	1,539,000	1,573,000	700,000
Friday	May 20	3,893,000			3,010,000	1,991,000	1,800,000
Saturday	May 21	1,594,000			3,199,000	1,518,000	1,924,000
Sunday	May 22	744,000		150,000	3,481,000	557,000	
Monday	May 23	1,877,000			2,000,000	1,576,000	1,900,000
Tuesday	May 24	502,000			1,700,000	89,000	1,800,000
Wednesday	May 25	840,000			2,857,000	2,292,000	300,000
Thursday	May 26	997,000			1,297,000	997,000	300,000
Friday	May 27	822,000			485,000	70,000	300,000
Saturday	May 28	653,000			1,285,000		1,400,000
Sunday	May 29	272,000			385,000		385,000
Monday	May 30	190,000			500,000		
Tuesday	May 31				24,000		700,000
Wednesday	June 1				176,000		
Thursday	June 2						
Friday	June 3				1,538,000	38,000	1,500,000
Total		60,569,000		778,000	42,712,000	11,850,000	29,882,000

In addition to the fish delivered as reported above, 918,000 eggs were delivered to car No. 3, May 30, for hatching and movement to Kentucky.

33.—A VISIT TO THE CHIEF FISHING PLACES OF JUTLAND.*

By C. G. VON OTERENDORP.

The principal result of my observations was to convince me that, if anything, the wealth of fish on the coast of Jutland is not so great as on the German coast of the North Sea; but the favorable results obtained are due to the energy and skill of the Danish fishermen, who, with much toil and danger, take this rich booty from the waves of the sea.

Fredericia was specially interesting for its extensive eel fisheries, in the Little Belt, and Randers for its large fiord fisheries, which unfortunately during my visit were seriously hindered by the ice. Of still greater interest to me was Frederikshavn, for at the time of my visit considerable quantities of Swedish herring were landed there by the Swedish fishing-boats, which are small but neat and seaworthy. These herring are carried by railroad to nearly every town and village in Jutland, where they are both a cheap and fresh article of food. Many are sent to the Sleswick-Holstein smokehouses, a large quantity goes to Germany, and car-loads of fresh herring are sent to Belgium.

The transhipment is managed in a practical and convenient manner, as the car-tracks run close to the landing-place of the fishing-boats, where the fish are transferred direct from the boats to the cars. The Danish Government is constructing an additional larger harbor-basin, as the present one has proved too small for the very considerable traffic, and no longer meets the demands of the fisheries.

Permission is readily granted to the fish-dealers to use the harbor for a larger number of fish-tanks. At the time of my visit these tanks contained only plaice and lobsters. Cod, eel, plaice, and lobsters keep very well in them; only when a cold east wind sets in, the lobsters suffer very much, because under these circumstances deeper tanks than those in use at present are required. The new harbor-basin will in every respect be better adapted to these purposes.

The best Swedish fishing-boats, admirably adapted to line-fishing, are said to be made by Isaac Andersen Russoe, of Strömstad. They cost about 3,000 crowns ($804) apiece, but have to be furnished with more ribs and an inner keel for use in the Danish waters. The fish caught all along this coast, as far as Skagen, are brought principally to Frederikshavn. The haddock caught in the neighborhood and brought here are small; but the cod, halibut, and plaice are larger and are brought in greater quantities. Large quantities of the last-mentioned fish are sent to the Sleswick-Holstein smokehouses, or to Copenhagen to be consumed fresh.

---

* "*Eine Reise nach den Hauptfischplätzen Jütlands.*" From *Mittheilungen der Section des Deutschen Fischerei-Vereins für Küsten- und Hochsee-Fischerei*, No. 3, Berlin, March, 1886. Translated from the German by HERMAN JACOBSON.

From the east coast I went to the north coast of Jutland, but as there is no protection whatever for fishing-vessels, only very light boats can be used on this open coast; they are principally open keel-boats, drawing 2½ to 3 feet of water, with a suitable quantity of water-ballast and a crew of three to five men. In line-fishing the Lönstrup, Löcken, and Blockhus fishermen use 7,200 hooks for catching haddock, cod, and halibut till February; and from February they catch plaice, and also haddock and lobsters, with seines. Experiments with the seines used on this coast, which are taken out by two boats, might be advantageously made on the German coast.

The conditions are very similar along the entire west coast of Jutland from Skagen to Riff Horn. In many places light and sometimes flat-bottomed boats, which are seaworthy on account of their breadth, are used, and are generally manned by two, four, and even seven fishermen. On this long coast-line many men are engaged in gaining a living from the sea, and thus benefit the country in general; but the lack of suitable harbors is felt keenly, and many lives are lost in these fisheries. The construction of harbors on this sandy coast would involve a considerable expense. The fishing population, however, is liberally assisted by the Government, which, among other things, places every year eight fishing-boats at the different stations, which may be used by the fishermen whenever their own boats have been damaged.

The Danish Government has not been slow in finding the most suitable places for constructing harbors. As I have already mentioned, a new harbor has been constructed at Frederikshavn, and another (called Esbjerg) on the southwest coast, in the shelter of the island of Fanöe. Fifteen years ago only one house was standing here, and today upwards of 2,000 people are living at Esbjerg. This place evidently has quite a future. It is the principal port of exportation for the products of Jutland; cattle, butter, and eggs, and in spring fish are sent from here to Newcastle and London, two steamers per week sailing for these ports. The expectation that fishermen would settle at this place has been realized, for about one hundred persons living at Esbjerg are engaged in the fisheries. The harbor of Esbjerg is much used by the Fanöe fishermen, and as a port of refuge by German fishermen.

The Jutland fishing-grounds are not so rich as those off the German coast of the North Sea, and the large quantities of fish caught off Jutland are owing to the circumstance that more persons are engaged in the fisheries than with us, and also because the fishermen follow more rational methods of fishing.

A Norderney line-boat (sloop) generally uses in line-fishing a line with 3,000 hooks per day, and is usually manned by three persons, sometimes three fishermen and a boy, so that of the profits three parts go to the fishermen, one part to the owner of the boat, and occasionally one-tenth to the boy. Some Danish boats have two fishermen; the boat represents but a small value, and is owned by the two fishermen in equal parts. They use 3,500 hooks, therefore more than our boats. Even if these Danish boats catch one-fourth less than our boats, the two Danish fishermen make as much, because their expenses are smaller and because their lines represent only a small capital. The same applies to the larger boats, which are worth from 400 to 500 crowns ($107.20 to $134), have a crew of 4 or 5 men, and use from 6,000 to 7,200 hooks. The advantage which the Danish fishermen have over ours becomes still more apparent where deck-boats are employed, as is the case at Esbjerg. These boats are very seaworthy, draw 5½ feet of water at the stern and 4½ feet at the bow; their length is 25 feet along the keel, and 35 feet over all on deck; and, like the Swedish boats, they are very broad. The price of such a boat is 2,500 crowns ($670) at the wharf. These boats have a crew of 6 to 8 men, and sometimes set as many as 15,000 hooks. It will easily be understood that this method of fishing is more remunerative than ours, as a Norderney boat, even under the most favorable conditions, if manned by 3 men (4 shares), catches about 1,500 fish, while an Esbjerg boat, manned by 8 fishermen, catches as many as 5,000 fish. Each one of our fishermen, therefore, gets about 370 fish, while each Danish fisherman (8 fishermen = 8 shares, boat = 1 share, total = 9 shares) gets about 550 fish. The Danish fishermen, can, therefore, afford to sell their fish somewhat cheaper. Our fishermen can catch 1,500 fish with 3,000 hooks; while the Jutland fishermen, who use five times as many hooks, ought therefore to catch five times as many fish (7,500), but this is not the case; and I am, therefore, convinced that our waters contain more fish than the Jutland waters; and, as a general rule, the plaice caught on the west coast of Jutland are leaner than ours. The large quantities of plaice caught on the coast of Jutland are sent to Sleswick-Holstein to be smoked, or by way of Frederikshavn to Copenhagen. Swedish fishermen buy plaice at Löcken, and take them as far as Christiania and other Norwegian ports. Whenever during the prevalence of south winds German fishermen are fishing near Riff Horn and beyond, and there catch sometimes a boat-load of plaice in 12 hours, it might be recommended to them, in case the wind prevents them from reaching the German or Dutch markets, to make an attempt to sell their fish in Norway, as no plaice are caught near the Norwegian coast, and as these fish fetch a good price there.

Of the Lymfiord fisheries, those for oysters were particularly interesting to me. It is well known that after (in 1825) the narrow neck of land which separated the Lymfiord from the North Sea was broken, oysters began to make their appearance in the fiord. The current probably carried the spawn into the fiord from the North Sea, for this oyster has exactly the shape of our North Sea oyster, but, owing to the condition and depth of the water, the shell of the fiord oyster is not so strong. Some years ago the Danish Government derived an income of 240,000 crowns ($64,320) per annum from renting out these oyster-fisheries, including a small bank in the Cattegat; while now the fisheries have gone down so much that the rent is only 48,000 crowns ($12,864) per annum. In my opinion this is caused by the circumstance that during continuous east winds too much water from the Baltic, which is not very salty, enters the fiord. It can hardly be supposed that severe frost should have caused the decline of the oyster fisheries, unless there are such undercurrents as to favor the formation of bottom-ice. The apparatus used in the Lymfiord for catching oysters seems to me very destructive, as the bow of the net has teeth instead of being smooth. The bottom, which is not very rocky, is therefore considerably torn up, and does not afford any firm hold for the young oysters. I was informed that various attempts had been made to raise oysters artificially, but so far without success. I think, however, that the waters of this large fiord must have many sheltered places where young oysters could be raised in large quantities.

Broom and heather placed horizontally, in hurdles 4 feet broad and 6 feet long, above the present oyster-beds, in places where there is the least possible current, would probably yield a favorable result. To prevent these hurdles from being covered with aquatic plants they should not be set till the 15th or 20th of May, as it will not hurt if they are overgrown with plants later. I would state regarding oyster culture that the spawn of oysters prefers to adhere to rough, dark brushwood. Heather and broom have been advantageously employed. Oyster fishing, and in fact all fishing, should be strictly prohibited in these places. I am confident that success will crown these efforts if they are made in places where there is but little current. The results would certainly be favorable if the hatching places were properly inclosed; but this, of course, is more expensive.

In conclusion, I would state how profitable oyster culture may be for a country. The Dutch oyster-beds near Jersecke in 1870 yielded a rent of 20,651 florins ($8,301.70), but after artificial oyster culture had been introduced these beds (including those of the East Scheldt) yielded an annual rent of 508,665 florins ($204,483.33).

Jersecke, which in 1870 was a poor fishing village with 1,013 inhabitants, has at present a population of 2,832. Twenty-two millions of cemented tiles serve as spawn-collectors in the East Scheldt and on the Jersecke oyster-beds; and in 1884 there were many tiles which held as many as 300 young oysters. The waters of the Lymfiord, in spite of having less food, would probably show even greater results.

The banks in the Zuyder Zee near the Island of Wieringen, which are rented out by the Dutch Government for the purposes of oyster culture, already yield an annual rent of 50,000 florins ($20,100), and this sum is paid for grounds which as yet have not produced any oysters, and which only as late as last year were supplied with mother-oysters from the great German oyster-beds in the North Sea.

NORDERNEY, GERMANY, *February* 25, 1886.

34.—REPORT OF SHAD DISTRIBUTION FOR 1887.

By MARSHALL McDONALD.

The number of shad produced for distribution the present season was unprecedented, and the season of active work being restricted to a comparatively short period, the capabilities both of the stations for production and of the means of distribution were taxed beyond their present capacity. To relieve the glut of eggs at Battery Station and Central Station shipments of eggs on trays were made both to the Cold Spring Harbor Station and to the hatching station of the Delaware State commission at Wilmington, an aggregate of 10,718,000 eggs during the season being forwarded to these stations. Further relief was obtained by recourse to the hatching arrangements aboard of car No. 3. The hatching *en route* proved uniformly successful and enabled us to triple the capacity of the car for the work of distribution, and at the same time to relieve somewhat the overcrowding of eggs at the stations.

Summary of production and distribution of shad and shad eggs, season of 1887.

	Fort Washington Station.	Central Station.	Battery Station.	Steamer Fish Hawk.	Total.
Eggs collected	59,435,000	....	59,239,000	29,834,000	148,008,000
Eggs received by transfer	....	57,385,000	*1,330,000	....	....
Total	59,435,000	57,385,000	60,569,000	29,834,000	148,008,000
Fish deposited in local waters	2,050,000	....	11,850,000	†18,934,000	32,834,000
Fish shipped to other waters	....	32,549,000	29,882,000	....	62,431,000
Eggs transferred to other hatcheries	57,385,000	....	....	*1,330,000	....
Eggs shipped to State commissions	....	8,718,000	....	2,000,000	10,718,000
Eggs delivered to car No. 3	....	3,469,000	918,000	....	4,387,000
Fish lost at hatchery	....	....	778,000	....	778,000
Eggs lost in incubation	....	‡12,649,000	17,141,000	7,070,000	36,860,000
Total	59,435,000	57,385,000	60,569,000	29,834,000	148,008,000
Gross out-put	2,050,000	44,736,000	42,650,000	20,934,000	110,370,000
Loss in transportation	....	1,138,000	807,000	....	1,945,000
Net out-put	2,050,000	43,598,000	41,843,000	20,934,000	108,425,000

*Includes 24,000 fry. †Includes 3,157,000 eggs. ‡Includes 11,935,000 eggs lost in transportation.

Summary by river basins of shad fry distributed during 1887.

River basin.	Shad.	River basin.	Shad.
Penobscot River	922,000	Shipped to Cold Spring Harbor to be hatched and turned into Hudson and tributaries	6,644,000
Kennebec River	1,047,000	Shipped to Wilmington, Del., to be hatched and turned into tributaries of Delaware Bay	4,074,000
Tributaries of Narragansett Bay	1,275,000	Total	108,425,000
Hudson River and tributaries	2,185,000		
Tributaries of Delaware Bay	5,099,000		
Tributaries of Chesapeake Bay	70,199,000		
Tributaries of Albemarle Sound	5,322,000		
Tributaries of North Atlantic coast	3,596,000		
Tributaries of Gulf of Mexico	7,048,000		
Inland waters	1,014,000		
Total planted by the U. S. Fish Commission	97,707,000		

The total production of eggs for the season was 148,008,000, of which there were lost during incubation and at hatchery 37,638,000 and during transportation 1,945,000, leaving the total number of fish and eggs for distribution for the season 108,425,000. The number of eggs produced and the number of fish and eggs distributed is exhibited by stations in the above summary:

Record of distribution of shad and eggs, season of 1887.

SHAD FROM CENTRAL STATION.

Date.	Waters stocked.	Place of deposit.	Number shipped.	Messenger.
1887.				
Apr. 29	Occoquan River	Wood Bridge, Va	365,000	Newton Simmons.
30	Quantico Creek	Quantico, Va	486,000	Do.
May 2	Acquia Creek	Acquia Creek, Va	425,000	Richard H. Dana.
3	Rivanna River	Charlottesville, Va	270,000	Do.
4	Broad Run	Bristoe, Va	326,000	L. D. Terrell.
5	Rapidan River	Rapidan Station, Va	523,000	Richard H. Dana.
6	Mattapony River	Milford, Va	338,000	C. A. Steuart.
8	Burnt Corn Creek	Brewton, Ala	574,000	W. A. Dunnington.
8	Big Escambia River	Flomaton, Ala	[1]574,000	Car No. 2.
9	Patuxent River	Laurel, Md	500,000	C. A. Steuart.
10	Patuxent River	Patuxent, Md	583,000	Do.
11	Broad Run	Bristoe, Va	398,000	J. E. Brown.
11	Mattapony River	Milford, Va	765,000	C. A. Steuart.
11	Little River	Taylorsville, Va	400,000	Do.
12	Catawba River	Catawba, S. C	300,000	Car No. 3.
12	Congaree River	Columbia, S. C	[2]1,796,000	Do.
12	North Anna River	C. & O. Junction, Va	750,000	C. A. Steuart.
12	Dan River	Danville, Va	1,431,000	Car No. 2.
12	Cedar Run	Catlett, Va	400,000	J. E. Brown.
13	Chickahominy River	Huntletts, Va	344,000	C. A. Steuart.
13	Mattapony River	Penola, Va	345,000	J. E. Brown.
14	Youghiogheny River	Oakland, Md	389,000	H. E. Quinn.
14	Chopowanisic Creek	Quantico, Va	400,000	J. E. Brown.
14	Quantico Creek	Quantico, Va	400,000	C. A. Steuart.
15	Hudson River	Albany, N. Y	[3]2,223,000	Car No. 3.
16	Chickasawha River	Enterprise, Miss	578,000	W. A. Dunnington.
16	Leaf River	Hattiesburgh, Miss	[4]578,000	Car No. 2.
17	Monongahela River	Fairmont, W. Va	582,000	H. E. Quinn.
17	Meherrin River	Bellefield, Va	546,000	C. A. Steuart.
17	Meherrin River	Bellefield, Va	457,000	Do.
17	Stony Creek	Stony Creek Station, Va	428,000	J. E. Brown.
18	Stony Creek	Stony Creek Station, Va	440,000	Do.
19	James River	Lynchburg, Va	500,000	Do.
19	Monongahela River	Grafton, W. Va	339,000	H. E. Quinn.
19	Otto River	Otto River Station, Va	500,000	C. A. Steuart.
20	Neabsco Creek	Freestone, Va	880,000	J. E. Brown.
20	Kennebec River	Augusta, Me	[5]1,396,000	Car No. 3.
20	Potomac River	Little Falls, Md	756,000	Joseph Mace.
21	Cheat River	Rowlesburg, W. Va	374,000	H. E. Quinn.
22	Rappahannock River	Fredericksburg, Va	938,000	J. E. Brown.
22	Rivanna River	Charlottsville, Va	819,000	C. A. Steuart.
23	Savannah River	Harbins, S. C	[6]1,230,000	Car No. 2.
23	North Anna River	C. & O. Junction, Va	736,000	C. A. Steuart.
23	Mattapony River	Milford, Va	912,000	J. E. Brown.
24	Mattapony River	Milford, Va	609,000	Do.
24	Powers Creek	Cherry Hill, Va	730,000	J. E. Brown.
24	Occoquan River	Wood Bridge, Va	700,000	C. A. Steuart.
24	Potomac Run	Brooke, Va	655,000	Do.
25	Nottaway River	Stony Creek, Va	585,000	Do.
25	Stony Creek	Stony Creek, Va	535,000	J. E. Brown.
26	Monongahela River	Clarksburg, W. Va	250,000	H. E. Quinn.
27	Six Runs	Clinton, N. C	389,000	S. G. Worth.
27	Pamunkey River	White House, Va	400,000	C. A. Steuart.
27	Fountain Creek	Margarettsville, N. C	400,000	J. E. Brown.
31	Jordan River	Salt Lake City, Utah	1,157,000	Car No. 2.
31	Ponds at station	Wytheville, Va	30,000	G. A. Jones.
June 3	Mohawk River	Schenectady, N. Y	200,000	William F. Page.
	Total		[7]34,934,000	

---

[1] Of this number 57,000 were lost in transit.

[2] Of this number 59,000 were lost in transit.

[3] Of this number 238,000 were lost in transit.

[4] Of this number 40,000 were lost in transit.

[5] Of this number 349,000 were lost in transit.

[6] Of this number 60,000 were lost in transit.

[7] Of this number 803,000 were lost in transit, leaving 34,131,000 as the number actually placed in the water.

SHAD FROM BATTERY STATION.

Date.	Waters stocked.	Place of deposit.	Number shipped.	Messenger.
1887.				
May 6	Susquehanna River	Battery Station, Md	229,000	Station employés.
9	Susquehanna River	Port Deposit, Md	500,000	Do.
10	Brandywine River	Wilmington, Del	[1] 2,200,000	Car No. 1.
10	North East River	North East, Md	300,000	L. D. Terrell.
11	Nantico River	Seaford, Del	[2] 2,200,000	Car No. 1.
11	Elk River	Elkton, Md	300,000	Richard H. Dana.
12	Bush River	Bush River, Md	360,000	Do.
12	Elk and Bohemia Rivers	Bush River, Md	2,000,000	Steamer Halcyon.
13	Gunpowder River	Gunpowder, Md	360,000	Richard H. Dana.
13	Tuckahoe River	Hillsborough, Md	[3] 1,800,000	Car No. 1.
13	Susquehanna River	Port Deposit, Md	420,000	Richard H. Dana.
14	North East River	North East, Md	360,000	Do.
14	Swan's Creek	Battery Station, Md	2,000,000	Station employés.
16	Pocomoke River	Whaleysville, Md	[4] 1,800,000	Car No. 1.
16	Susquehanna River	Fites Eddy, Pa	360,000	Richard H. Dana.
17	Susquehanna River	Peach Bottom, Pa	560,000	Do.
17	Susquehanna River	Battery Station, Md	973,000	Station employés.
18	Susquehanna River	Safe Harbor, Pa	300,000	Richard H. Dana.
19	Appoquinimink Creek	Middletown, Del	75,000	Car No. 1.
19	Blackbird Creek	Middletown, Del	75,000	Do.
19	Smyrna Creek	Clayton, Del	75,000	Do.
19	Leipsic Creek	Morton, Del	75,000	Do.
19	Jones Creek	Dover, Del	75,000	Do.
19	Murderkill Creek	Felton, Del	75,000	Do.
19	Mispillion Creek	Milford, Del	75,000	Do.
19	Broadkill Creek	Ellendale, Del	75,000	Do.
19	Indian River	Millsborough, Del	400,000	Do.
19	Chester River	Chestertown, Md	400,000	Steamer Halcyon.
19	Susquehanna River	Safe Harbor, Pa	300,000	Richard H. Dana.
19	Susquehanna River	Battery Station, Md	1,573,000	Station employés.
20	Susquehanna River	Marietta, Pa	300,000	Richard H. Dana.
20	Susquehanna River	Harrisburg, Pa	1,500,000	Car No. 1.
20	Susquehanna River	Battery Station, Md	1,991,000	Station employés.
21	Susquehanna River	Battery Station, Md	1,518,000	Do.
21	Brandywine River	Wilmington, Del	1,924,000	Car No. 1.
22	Susquehanna River	Battery Station, Md	557,000	Station employés.
23	Susquehanna River	Battery Station, Md	1,400,000	Do.
23	Susquehanna River	Battery Station, Md	176,000	Do.
23	Tuckahoe River	Hillsborough, Md	1,600,000	Car No. 1.
23	Bush River	Bush River, Md	300,000	Richard H. Dana.
24	Elk River	Elkton, Md	300,000	Do.
24	Taunton River	Dighton, Mass	[5] 1,500,000	Car No. 1.
24	Susquehanna River	Battery Station, Md	89,000	Station employés.
25	Susquehanna River	Battery Station, Md	2,292,000	Do.
25	Patapsco River	Relay Station, Md	300,000	L. D. Terrell.
26	North East River	North East, Md	300,000	Do.
26	Susquehana River	Battery Station, Md	997,000	
27	Susquehanna River	Battery Station, Md	70,000	Station employés.
27	Bush River	Bush River, Md	300,000	L. D. Terrell.
28	Nantico River	Seaford, Del	1,400,000	Car No. 1.
29	Gunpowder River	Gunpowder River, Md	385,000	L. D. Terrell.
30	Ohio River	Louisville, Ky	[6] 1,618,000	Car No. 3.
June 3	Susquehanna River	Battery Station, Md	38,000	Station employés.
5	Etowah River	Cartersville, Ga	[7] 450,000	Car No. 1.
5	Oostenaula River	Resaca, Ga	[8] 1,050,000	
	Total		[9] 42,650,000	

---

[1] Of this number 25,000 were lost in transit.
[2] Of this number 220,000 were lost in transit.
[3] Of this number 90,000 were lost in transit.
[4] Of this number 36,000 were lost in transit.
[5] Of this number 225,000 were lost in transit.
[6] Of this number 918,000 were eggs when placed on the car, and 137,000 were lost in transit.
[7] Of this number 22,000 were lost in transit.
[8] Of this number 52,000 were lost in transit.
[9] Of this number 11,850,000 were deposited in the local waters mentioned in the table, 807,000 were lost in transit, as specified in preceding foot-notes, and 29,993,000 were planted in other waters.

The number of shad eggs sent out to be hatched elsewhere is shown by the following table. It is not possible at this time to state the waters stocked, the consignees not having yet reported upon the subject.

SHAD EGGS FROM CENTRAL STATION.

Date.	Consignee.	Place of deposit.	Number shipped.
1887.			
May 6	Dr. E. G. Shortlidge*	Wilmington, Del	2, 074, 000
7	Fred Mather *	Cold Spring Harbor, N. Y	2, 414, 000
15	E. G. Blackford*	do	2, 029, 000
20	E. M. Stillwell*	Bangor, Me.†	‡1, 084, 000
21	E. G. Blackford*	Cold Spring Harbor, N. Y	2, 201, 000
	Total		9, 802, 000

*Delivered by car No. 3.

†For the Penobscot River.

‡Of this number 162,000 eggs were lost in transit.

FROM STEAMER FISH HAWK.

Date.	Waters stocked.	Place of deposit.	Shad and eggs.
1887.			
May 4	North East River	Havre de Grace, Md.	1, 184, 000
5	do	do	1, 845, 000
6	do	do	713, 000
6	Sassafras River	do	1, 250, 000
7	North East River	do	*3, 157, 000
8	do	do	261, 000
9	do	do	401, 000
10	do	do	997, 000
11	do	do	1, 577, 000
12	do	do	1, 527, 000
14	Chester River	do	1, 054, 000
16	North East River	do	1, 038, 000
17	do	do	994, 000
18	do	do	740, 000
19	do	do	574, 000
20	do	do	1, 196, 000
21	do	do	251, 000
22	do	do	175, 000
	Total		18, 934, 000

*Eggs not quite ready to hatch.

In addition to the above, 2,000,000 eggs were delivered, May 13, to the Delaware commission.

The most important experiment looking to the acclimatization of shad in new rivers was made in connection with the hydrographic basin of Great Salt Lake. This inland sea would seem to present all the conditions necessary for the reproduction of the shad under natural conditions. The value that would arise to the inhabitants of that section of the country from the introduction of some anadromous species like the shad in their waters was so evident, that it was determined by Professor Baird, the Commissioner, to test by an exhaustive experiment the capabilities of these waters to supply the necessary conditions. Accordingly car No. 2, with 1,000,000 fry, was sent to Utah and the fish successfully planted. The deposit was made in the Jordan River, it being deemed better to concentrate all the fish in a single plant than to distribute them in smaller numbers to tributary streams of Utah Lake. It is in contemplation to repeat this work for two successive seasons.

From the rapid increase in the volume of the work of shad distribution it is evident that it will be necessary to increase the efficiency of our distributing service in order to meet the demands that will probably be made upon it next season. This may be accomplished in two ways: First, by the establishment of auxiliary field stations in those river basins which are to be stocked with shad. These stations should be properly equipped to give them a capacity of six or eight million eggs at one time. To these at the proper season a car can be dispatched carrying a full complement of eggs in one shipment, in this way quadrupling the present capacity of the cars in the work of distribution and reducing the cost of distribution per million *pro tanto.* Second, to increase the capacity of the producing stations so as to enable us to take care of all eggs at these stations until hatched. This would necessitate an increase in the number of cars for distribution; one or two at least in addition would be needed to provide for the anticipated increase in the volume of this work. Full details of distribution by stations, showing the streams stocked, the locality of the plant, and the number planted in each case are herewith given.

WASHINGTON, D. C., *July* 6, 1887.

35.—THE FINWHALE FISHERY ON THE LAPLAND COAST IN 1886.

By ALFRED HENEAGE COCKS, F. Z. S.

[Abstracted from the Zoologist, London, England, for June, 1887.]

The finwhaling season of 1886 off the north coast of Norway and Russia proved a good one as far as the number and size of the whales were concerned, but, owing to the continued low prices of oil and baleen, the result is not entirely satisfactory.

Rudolphi's rorqual, which in 1885, for the first time on record, appeared in such large numbers to the eastward of the North Cape, in 1886 confined itself again to its usual habitat, only 8 individuals being taken by ships of the companies having their stations to the east of that headland; and it is quite likely that some, and possibly all of this small number, were actually killed to the west of Cape North. None were even seen by the Russian boats.

The blue whale reappeared last year in more like its former numbers; but there was an appreciable falling off in the catch of this species as regards the Norwegian coast, though apparently this was not the case in the eastward portion of the Russian waters. A comparison for 1884, 1885, and 1886 of the numbers of common rorquals killed will show a steady increase, the totals for each company in 1886 averaging more than double the number obtained in 1884. The totals of humpbacks killed during each of these three years were very nearly the same.

With regard to the time when the different species of finwhale appear on the North European coast it may be stated that probably the first whale killed last year was a humpback, yielding about 39 barrels of oil, which was taken on February 24. Humpbacks are said to arrive on the east Finmark coast every February, but the weather was so bad this year as to hinder the fishing; but it is probable that their numbers are recruited towards the end of the fishing season. A few common rorquals were seen in March. Most of the catch of whales, however, during the season was made during the three summer months.

The apparent considerable excess of males over females among the humpbacks captured this season was quite noticeable. Out of 37, of which the sex is recorded, 28 were males. This is not to be accounted for by supposing that male animals are selected where there is a choice on account of greater size, for the contrary is the case. The average for the males recorded is under 35⅙ feet, while that of the females is just over 40⅓ feet.

Most of the blue whales obtained were of large size and in very good condition. The sex of a blue whale (and in a less marked degree it is, I believe, true of other species of *Balænoptera* and possibly of other whalebone whales) may be distinguished by the shape of the baleen plates, which in a male are long (up to 4 feet including gum) and narrow but thick, while in a female they are short and broad, but thinner.

The common rorqual is extremely variable in some of its peculiarities, which has led to the multiplication of species and great confusion, but it seems now as if these differences might be classified under three constant varieties. Nearly universally recognized among the finwhalers is the so-called "bastard whale," from its having been supposed to be the offspring of mixed parentage of a blue whale and a common rorqual. This variety appears to attain to larger dimensions than the typical form, and is described as gray rather than the usual white on the under side, and on one side the baleen plates are for a short distance at the anterior end entirely white, while the remaining portions are darker than the normal color. Capt. S. A. Nilsen, of the Murmanetz, says that he sees common rorquals pairing during May up to about June 1 every year, and that in the spring they have calves by their sides not more than 8 or 9 feet long.

The following prices offered for baleen about the middle of the season show the relative values per ton of each species, the plates to be not under 35 centimeters (13¾ inches) long: Blue whale, £65 ($316); Rudolphi's rorqual, £40 to £45 ($195 to $219); common rorqual, £30 ($146), and humpback, about £30 ($146).

Some idea of the size of the harpoons used may be gathered from the weight of one. Including the wire grummet, cord, and spun-yarn lashings, but without the shell or whale-line, it weighed 56 kilograms (over 123 pounds). The cost of each is 80 crowns ($21.44) as it leaves the blacksmith, and nearly 100 crowns ($26.80) when ready for use.

During the season the catch obtained by the different companies (having about 22 establishments) amounted to 954 whales, of which there were, it is believed, 152 blue whales, 646 common rorquals, 62 Rudolphi's rorquals, and 94 humpbacks. These were taken by 39 whalers, and yielded very nearly 30,000 petroleum casks of oil.

36.—REPORT ON THE SHAD WORK OF THE STEAMER HALCYON DURING THE SEASON OF 1887.

By WILLIAM HAMLEN.

[Abstract.]

During the period of the shad operations of the steamer Halcyon, which commenced on May 2 and ended on the 20th of the same month, 4,750,000 fry were obtained from the U. S. Fish Commission steamer Fish Hawk, and from Battery Station, and planted; and 8,629,000 eggs were secured through the agency of gillers. The spawning, which was all done at night, was continued until the end of the season.

On May 11 the steamer Fish Hawk transferred to the Halcyon 1,250,000 young shad, which, on that date, were planted in the Sassafras River.

The Halcyon then proceeded to Beaver Dam, on the Susquehanna, the nearest point where successful spawning could be carried on, but arrived too late to accomplish anything in that line.

All the eggs obtained were kept fresh and in good order by means of hatching cones and pumps on the vessel, until it was practicable to transfer them to Battery Station.

The following table shows the number of eggs and fry obtained, and how disposed of:

Record of shad operations by steamer Halcyon, on Chesapeake Bay and tributaries, for the season of 1887.

Date.	Place.	Eggs taken.	Fry received and deposited.	Time of deposit.	Place of deposit.
1887. May 2	Main channel, Susquehanna River.	270,000	....	....	
3	......do..........	153,000	....	....	
4	Red Bank, Susquehanna River.....	37,500	....	....	
5	Odenton channel, Susquehanna River.	721,500	....	....	
6	Red Bank, Susquehanna River.....	438,000	....	....	
7	......do..........	68,000	....	....	
9	Beaver Dam, Susquehanna River ..	1,733,000	....	....	
10	......do..........	2,469,000	....	....	
11	....	....	*1,250,000	May 11	Sassafras River.
12	Battery Haul, Susquehanna River .	658,000	†1,100,000 †1,000,000	May 12 May 12	Bohemia River. Elk River.
13	Penny Shoals, Susquehanna River .	126,000	....	....	
14	......do..........	207,000	....	....	
15	......do..........	578,000	....	....	
16	Osbern's Haul, Susquehanna River.	460,000	....	....	
17	Beaver Dam, Susquehanna River ..	315,000	....	....	
18	Main channel, Susquehanna River .	136,000	....	....	
19	Sandy Beach, Susquehanna River..	32,000	†400,000 *1,000,000	May 19	Chester River.
20	Beaver Dam, Susquehanna River ..	227,000	....	....	
	Total	8,629,000	4,750,000	....	

* Received from steamer Fish Hawk. ‡ Received from Battery Station.

BALTIMORE, MD., *August* 15, 1887.

37.—CATCH OF SHAD IN CONNECTICUT FOR 1887.

By ROBERT B. CHALKER.

The statistics of the catch of shad for the year 1887 in the State of Connecticut are as follows:

POUND FISHERIES.

From the mouth of the Connecticut River to New Haven Harbor:		
15 traps in Saybrook	26,700	
21 traps in Westbrook	26,600	
10 traps in Clinton	8,650	
18 traps in Madison	1,800	
7 traps in Guilford	1,500	
8 traps in Branford	2,000	
5 traps in East Haven	4,000	
Total shore fisheries		71,250

RIVER FISHERIES.

Thames River	27	
Connecticut River and tributaries:		
Hauling-seines	10,100	
Gill-nets	13,900	
Quinepiac River, hauling-seines	2,500	
Housatonic River:		
Hauling-seines	8,400	
Stake-nets	4,000	
Total river fisheries		38,927
Total catch of shad in the State		110,177

The past spring was a time of remarkably calm weather, as there was not a day during the fishing season when the Sound fishermen could not haul their nets. The run of shad was about the same each day, none of the usual large hauls being made. The fish were of uniform size and of very fine quality.

The first shad was caught April 18 in the Connecticut River, 5 miles from the mouth. The season closed suddenly about June 12, fifteen days earlier than usual.

The falling off in the catch is very great every year in all the waters of the State, but it is most marked in the Thames River. Formerly the fishermen would sometimes take 2,000 shad at a haul. It has decreased in a few years, so that now the total catch reported for the last two years has been but 45 and 27 respectively.

SAYBROOK, CONN., *September* 24, 1887.

Vol. VII, No. 8. Washington, D. C. Oct. 12, 1887.

38.—HATCHING COD IN NORWAY.[*]

By CARL ROGNERUD.

[Report of the codfish hatchery at Flodevig, Norway, for the year 1886.]

The unusual low temperature of the sea-water has this year put several new obstacles in the way of the work, so that the results, although better than those of preceding years, have not come up to what might have been expected, when we take into consideration the advantages of the accumulated experience of many years.

The greatest obstacle to the work was caused by the ice, which prevented parent fish from being obtained at the most important time, namely, from the 26th of February to the 30th of March. After that date it is always very uncertain and difficult to get fish which are not either too far advanced in spawning or have not already spawned.

When, nevertheless, a larger number of eggs was incubated than in previous years, it must be ascribed to the method of keeping the parent fish swimming in a special place in the hatching-house, instead of, as formerly, in an open vessel by the wharf.

In further explanation I may say that already in 1884 I noticed that a very large portion of the roe we received was dead when taken from the fish, and consequently useless for incubation to such an extent that three-quarters had to be discarded. It became of the greatest necessity to find out the reason for such a great loss and how it could be prevented or at least minimized. To assist me in this matter I applied for information to several persons of experience, but even with their assistance the problem could not be satisfactorily solved. The only way open to me was to proceed with the necessary investigation myself, and after a long time my labor was at last crowned with success.

The specific gravity of the roe is the surest sign of its being dead or alive. When alive, it floats easily in water with a specific gravity of 1.024; whereas if dead, it sinks and lies on the bottom, even when the specific weight of the water is increased by the addition of salt solution to 1.030. This fact is taken advantage of to remove the dead and useless roe when the apparatus is cleaned. When the roe is taken from the fish, fecundated, washed, and put in a large glass cylinder with water of a specific gravity of 1.022 to 1.024, a difference will at once be noticed between the good and useless. The living roe will after a few minutes float up to the under part of the surface, and the dead sink to the bottom, leaving a space of clear water between the two.

---

[*] Translated from the Norwegian by N. OHMAN.

The difference with regard to color begins now also to be noticed. The living roe is more or less of a yellowish-red color, whereas the dead is of a gray color, with a regular white spot on the under side of each egg. That the healthy color was lost with life was so natural that I passed it without any further investigation; but my whole attention was directed to the examination of the above-mentioned white spot, which was invariably found in all dead eggs, when taken directly from the fish, as well as when they had been in the hatching apparatus any time. They all presented, under the microscope, a cloudy apppearance, as if a white membrane lay on the bottom of each egg. Later on, I became convinced that such was the case; for the white spot was simply the membrane bag which contains the yolk (vital fluid), and sinks to the bottom of the egg after being broken and its contents mixed with the white of the egg.

It appeared as if outside violence to the fish was the cause of the eggs being thus destroyed (as, for example, pressure on the belly of the fish); and I began to feel so sure on that point that I came to the conclusion that to handle the parent fish with care would be the surest way to prevent its occurence, when an incident came to my assistance and led my researches in another direction. Among the fish procured was a splendid pair of light-gray deep-sea cod, one a roe and the other a milt fish. All the roe from time to time obtained from these fishes was, to my great regret, useless, and at last I gave up all hope of getting any hatchable roe from them; but as they were fine specimens and of a very large size, I decided to keep them in the hatchery basin, for the benefit of visitors and spectators. The water in which they were kept was often renewed with fresh sea-water, taken from a depth of 9 fathoms. Some time afterwards I happened by chance to catch one of them, and to my surprise I got exclusively good roe from it, and in considerable quantities.

Experiments were commenced with a greater number of fish which had given more or less bad roe, and when the result in all cases was the same it was considered clear proof that the saltness of the water must be taken largely into consideration. It may be remarked that the water pumped into the hatchery from a depth of 9 fathoms contains twice the quantity of salt as that on the surface.

It still remained to be explained why some fishes gave only useless roe, while all of them lived under exactly the same conditions and in the same place. I noticed that, as a rule, small-sized fish, of a dark color, gave the best roe for hatching, and, on the contrary, the light ones gave bad. Now the fish of light color live outside the coast in deep water; 'and the darker live closer to the shore, and are commonly called fiord fish, bay or shore fish. I was convinced that it was not the greater or less amount of salt the water contained that made the difference, but the sudden change from the deep-sea to the fresher water on the surface. This was also further proved by some deep-sea cod that were held captive by the shore from one year to the other, and were then found to give roe perfectly good for hatching. In consequence of these observations, all the parent fish for this year were kept in a reservoir in the hatchery; and from them was got a manifold greater quantity of roe. This can be easily understood when I mention that, during the breeding season this year, notwithstanding the low temperature of the water by which more roe was lost than in any previous year, we had only 150 fish, against 400 to 500 the previous year, from which roe were obtained. The loss in the apparatus this year amounted to 52.8 per cent., against 39.3 per cent. in 1885.

We must not conclude from this fact that the coldness of the water has a directly killing effect on either the roe or young fish. Such is not the case; but the hatching period is so much prolonged, and necessitates the keeping of the roe for a longer time in the apparatus, where it is subjected to injury and loss.

The time required for hatching cod eggs this year was forty-two days, whereas the longest time, in any previous year, was twenty-six days; the difference in the mean temperature was only 2.5° Réaumur. At a temperature of 4° R. [41° F.] it takes as a rule twenty-two or twenty-four days to bring out the young fish; and as they then appear to be strongest and most vigorous, we may suppose this to be the temperature best adapted to their nature. If the water is warmer, as for example, 6° R. [45½° F.], the hatching will be done in fifteen or eighteen days; but then the young fish are very frail and weak. The same is the case if the temperature is as low as 2° R. [36½° F.] or lower.

When the doubt regarding the possibility of hatching cod roe artificially was clearly removed, another question was brought forward, namely, had the young fish, hatched in this manner, energy and power enough for further growth and development in the natural element?

It was useless to explain that the conditions were the same as for those hatched naturally; that the temperature and saltness of the water, &c., were the same as in the sea; that the fecundation of the eggs and the progress of hatching must absolutely be the same as nature's arrangement, or else would have failed. The public wanted proof; and as the same public kept the institution going by their subscriptions, there was no choice but to set to work and bring such proofs.

A number of propositions were brought forward regarding the best course to adopt, and all had taken the economical question most strongly into consideration. That the same question had a prominent place in my calculations was natural; but the main point with me was to guard against anything being done or adopted that would in any way endanger the complete success of the work. I looked upon the question from the standpoint that a failure in this case would place too strong a weapon in the hands of skeptics, and our fish-breeding institutions would come to an end.

I had from time to time been experimenting on a small scale with young cod, and found that the water must have, besides the proper temperature, a specific gravity of 1.022, which is absolutely necessary in order to keep them from sinking to the bottom. If the specific weight of the young fish is more than that of the water they have too great a tendency to sink; and as their swimming power in their early stage is very small, they will touch the bottom at last, no matter how they struggle against it, and then their destruction is certain.

In view of these facts, it was considered necessary to construct a basin in such a place and in such a manner that the saltness of the water and its renewing would be under absolute control. I therefore proposed one entirely separate from the sea, which could be filled with proper sea-water by aid of a steam pump. A good place for such a basin was easily found. A plan of such was sent to the branch directors, which they accepted, and the work was commenced and finished during the fall of 1885. The dimensions of the basin are: Greatest length, 43 meters; greatest breadth, 20 meters; greatest depth, 5 meters [about 140 by 66 by 16 feet].

The capacity is about 2,500 cubic meters [about 88,000 cubic feet], and its overflow lies about 8 meters [26¼ feet] above sea-level. It is situated in a natural indentation in the cliffs and has a wall 40 meters [131¼ feet] long to the south, and one 15 meters [49¼ feet] to the northeast. The pumping is done by a small steam-engine and a windmill, erected in the neighborhood; but they are found rather too weak to perform the work satisfactorily, especially as a hill to the southeastward shelters the windmill from that direction.

During the month of April the basin was cleaned out and filling it was commenced, during which several kinds of sea-plants were put in. On the 3d of May about 500,000 young cod, hatched on the 27th of April, were put into it; the pumping continued steadily until the basin was filled, and afterwards at certain intervals.

With regard to the further progress of the young cod, I copy from my day-book as follows:

May 3–8.—Saw the fry every day, most of them at the eastern side. They never swim in schools, always by themselves.

May 9.—Development goes on. In the most of those I examined was seen a yellow content.

May 10.—The greatest number were seen about the mouth of the pipe through which the water was pumped in, probably because the water was fresher there than elsewhere in the basin.

May 11.—Continue to grow. Yellow spots are seen on the head and backs. Great numbers of crab larvæ (zoea stage) are found in the basin, and are very lively, swimming about near the waste-water overflow.

May 13.—About 5,000 young fry were put in the basin. Cod fry grow steadily, and, as mentioned before, are in greatest numbers about the filling pipe. The length is about 7 millimeters [¼ inch]. The intestine has begun to form a bend. The ground color is more yellowish. Temperature, 8° R. [50° F.]; specific gravity of water, 1.021.

May 18.—Cloudy and rain. Saw a number of cod fry of 8 millimeters length.

May 20.—Clear weather; fry all over the basin.

May 21.—Towards the evening, they gather to the west side of the basin. Length of fry, 10 millimeters.

Places of taking temperature, &c.	Temperature.		Specific gravity.
	°*R*.	°*F*.	
At overflow	10	54.5	1.0227
At 1 meter depth	10	54.5	1.0227
At 2 meters depth	9.7	53.8	1.0227
At 3 meters depth	0.5	53.4	1.0227
At bottom	9.5	53.4	1.0230

May 23.—The fry prefer to keep themselves in the shade, consequently they are at the east side in the morning and west side in the evening. The difference in the size is considerable, but the development is nearly the same. The distinction between the different kinds has already commenced to be noticeable.

May 31.—From last date the weather has been cold and rainy and observations insufficient. To-day are seen a great number of them. Caught one 15 millimeters long [a little over ½ inch]. They still like the shade.

June 1.—Saw a young flat-fish among the cod, all in the shade.

June 3.—It is a month to-day since they were put into the basin. Caught and preserved 50 of them in spirits of wine. They are now from 9 to 16 millimeters long. The smaller do not seem to have the same degree of development as the larger.

June 6.—Temperature in the basin 12½° R. [60° F.]; temperature in overflow, 10½° R. [55½ F.]; temperature in filling pipe, 6° R. [45½ F.]. That the water was so much colder in the filling pipe was because it was pumped from a greater depth. The fry are growing and are found over the whole basin. Tried to feed them to-day with fine-cut mussels and fish, etc., but it was no use; they fled in great haste from it.

June 8.—During the last days they seem to have disappeared in great numbers from the upper part of the basin, and keep closer towards the bottom. Caught one at two fathoms of water.

June 10.—After carefully studying the life and habits of the cod fry from early morning and during the whole day (a clear, calm, and sunny day), I have found that they attack, kill, and eat each other in considerable numbers, whereas the crab larvæ (now both in the zoea and megalops stage) were seldom pursued, and, as far as I could see, were never caught by the young cod; not that they seemed to lack the desire to catch them, but the larvæ are such splendid swimmers, and understand so well how to avoid the attack. On the other hand, I never saw a crab larva attacking the cod, so they may grow and develop peaceably together, for a time at least. That the larvæ at last succumb to the voracious cod is certain, but not until his size is considerably larger than the crab. As the cod, when larger, very seldom attack and eat each other, we may conclude that the greediness which they at present have is because the basin is new, and only a few sea-plants are yet growing there, so that there is not sufficient food in it for such a number of fish. Tried to feed them and succeeded in getting some of them to swallow pieces of finely-powdered mackerel.

June 19.—During the course of the last nine days numbers of cod have been examined, and their stomachs were filled with several kinds of animalculæ, such as mosquito larvæ and pupas, of which there is an incredible number in the basin. There were also found in them part of the food daily thrown into the basin for them. Some were found dead by the overflow, and marks of outside violence were visible, their hind-parts bloodshot and the skin injured.

When the young cod leave the egg they have a length of 3 millimeters. During the first eight days, while the yolk sac is able to give sufficient nourishment, they grow 2 millimeters, so that when taken out of the apparatus they have a length of 5 millimeters. [It takes a trifle over 25 millimeters to make 1 inch, so 5 millimeters equal about $\frac{1}{5}$ inch.]

Their future growth is varying indeed, and depends more perhaps on the difference in race kinds than on the greater or less quantity of food they succeed in obtaining; and when in the following table I give their length, it must be understood to be the average:

Date.	Age.	Length in millimeters.	Length in inches.
	Days.		
April 26	0	3	.12
May 3	6	5	.20
May 16	19	7	.28
May 18	21	8	.31
May 21	24	9	.35
May 31	35	10	.39
June 3	38	12	.47
June 6	41	15	.59
July 12	77	55	2.17
August 12	108	70	2.76
September 12	139	85	3.35
October 12	169	*115	4.53

* The largest one caught at this time was 157 millimeters [or 6.18 inches] long.

Between the 6th of June and the 12th of July there is a very large step in the development, as the table shows; but the reason is that at this time the young cod begin to eat the food given them twice a day, and in considerable quantities.

From the middle of October until now (middle of February) their growth has been very slow, the causes of which may be easily explained. I will here mention, first, that young cod, in their natural element, betake themselves to the deep waters when the upper waters begin to be cold, which usually takes place in the month of November. That at the same time they go, as it were, into the mouths of their many enemies, and the largest number of them are thus destroyed, has nothing to do with the present question. Those who escape all danger, no doubt, have a very comfortable existence in the deep waters, where they are able to procure for themselves a sufficient quantity of food in addition to the congenial temperature. That such a migration could not take place in the basin was evident; and all they could do was to search out the deepest holes, where they keep themselves as well as they can. That this is hindering their growth is easy to see, and especially as they during the cold weather eat almost nothing.

I may also mention, in this connection, that the water has not been renewed in the basin as often as might have been necessary, and may not have been so healthy for the young cod to live and thrive in. I have, nevertheless, seen only one dead in the basin during the winter, but that there may be more of them dead is quite possible, in the deeper holes, where the bottom cannot be seen.

Had this experiment been carried out to its fullest extent, the steam pump should have been kept going at least two whole days in each week, but the means at our disposal would not allow that.

The principal question is, however, satisfactorily settled: That the cod fry artificially hatched have the power and energy to live, grow, and develop when set at liberty and left to care for themselves in their natural element, the sea.

We must thus leave this question to rest for the present, especially as so many others of great importance in this connection are yet before us for solution. I shall again refer to the progress of the young cod in my early report for 1887. As the basin is now and has been covered with ice since the middle of December, I cannot venture to say how many are alive there yet, but I should suppose they still amount to several thousands.

Table showing the work during three winters.

Year.	Eggs taken.	Young cod let out into the sea.	Loss, per cent.
1884	12,575,000	5,095,000	59.5
1885	48,760,000	29,620,000	39.3
1886	68,880,000	32,510,000	52.8

ARENDAL, NORWAY, *January* 1, 1887.

39.—NOTES ON THE HATCHERIES AND FRESH-WATER FISHERIES OF ICELAND.

By BENED. S. THORARINSSON.

In 1883 the Icelanders began the first inquiry into the fisheries of their lakes and rivers. The first step in this direction was made by the assembly of Iceland (*Althing*) granting a total amount of 3,000 crowns ($804) for these investigations. Mr. Arthur Feddersen, editor of the Danish Fiskeritidende, was engaged to examine the rivers and lakes of Iceland and to report upon their condition. Accordingly, in the summer of 1884 he traveled through the country and published descriptions of the fresh-water fisheries of Iceland and a report of his examinations.* Also, he advised the establishment of two hatcheries, one for salmon, at Reynivellir; the other for trout, at Thingvellir.

For the hatchery at Reynivellir a hut of earth and stones was built, 11¼ by 8¼ feet, with a small window at one end and a narrow and low door. This hut cost 140 crowns ($37.52). It is situated at the foot of a slope, in boggy ground. The spring-water is conducted by a channel through the upper part of the wall into the hut, where it falls into a filtering box. The hatchery contains five California hatching-troughs, and it is not possible to hatch more than 30,000 eggs.

The person who conducted the hatchery, Mr. Nils Johanson, a Swedish farmer, kept a daily journal giving the temperature of the air and water. According to this journal, a partial table of the temperatures is as follows:

Partial temperatures during the hatching season.

Date.	Air.		Water.		Date.	Air.		Water.	
	Cent.	Fahr.	Cent.	Fahr.		Cent.	Fahr.	Cent.	Fahr.
	°	°	°	°		°	°	°	°
Oct. 16, 1884	6	42.8	6.5	43.7	Feb. 3, 1885	—6.5	20.3		
Oct. 27, 1884	4	39.2			Feb. 10, 1885	—6	21.2		
Oct. 28, 1884	—4	24.8			Feb. 14, 1885	—9	15.8		
Nov. 1, 1884			2–3	35.6–37.4	Feb. 23, 1885	—9	15.8		
Nov. 7, 1884	2	35.6			Feb. 28, 1885	—10	14		
Dec. 20, 1884	—6	21.2			Mar. 1, 1885	—7.5	18.5	2.5–3	36.5–37.4
Dec. 21, 1884	3	37.4			Mar. 13, 1885	6	42.8		
Dec. 27, 1884			1–2	33.8–35.6	Apr. 2, 1885	—10	14		
Dec. 28, 1884	—6	21.2			Apr. 20, 1885	4–7.5	39.2–45.5		
Jan. 21, 1885	4	39.2			Apr. 21, 1885			4	39.2
Feb. 1, 1885			0	32					

At a waterfall in the Laxá River a box was placed in which to retain the salmon taken for spawning purposes. Fishing for these spawning fish began at the salmon fall (*Laxfoss*) on September 26 and lasted till

---

* For three articles by Mr. Feddersen on this subject, see Fish Commission Report for 1884, pp. 301 and 323, and Fish Commission Bulletin for 1886, p. 161.

October 7; 3 females and 5 males being caught. In the Bugda River, near by, the fishing lasted from October 1 to 19; 10 females and 13 males being caught. Thus altogether 13 females and 18 males were taken. This number diminished considerably before spawn was obtained, as the stream was too strong in the retaining boxes, and the fish were not sufficiently cared for. The first salmon eggs were artificially impregnated in Iceland on October 16, 1884. This was continued until November 8, there being fecundated in all from 26,000 to 27,000 salmon eggs.

On December 23, sixty-nine days after impregnation, the development of the embryo was so far advanced that the eyes were visible in those that were fecundated on October 16; on January 5 the eyes were perceived in eggs impregnated October 28; and the eyes of those impregnated November 8 appeared on January 28. It is worth noticing that Mr. Johanson put snow into the water in order to make it colder for the purpose of delaying the hatching, because he thought it unsafe to put out the fry into the rivers till May. It seems, also, that hatching was especially delayed during the latter part of the season.

The first fry appeared on March 4, so that the period of incubation for these was about one hundred and forty days; but the journal stated that on March 23, everything of the first lot of eggs impregnated had been hatched, so the whole period extended over one hundred and sixty days. By April 28 the whole number of fry were hatched.

Owing to heavy rains the filtering box often became unclean from the settling of mold and mud that fell into it. Ducks often stirred up the soil in the bog, which also caused the water to be muddy; and so both gravel and box had to be cleansed repeatedly.

The fry were kept in the hatching-boxes till May 23, when nearly 10,000 young fish were planted in Bugda River; and on the 25th of May 12,000 were planted in Laxá River, above Vindás. The temperature in the Bugda at this planting was 10° C. [50° F.], and 8¾° C. [47¾° F.] in the Laxá. Of the whole number fecundated (from 26,000 to 27,000), there died 1,030 eggs; while probably the total loss was about 13 per cent.

On March 1, when the embryos were well developed, Mr. Johanson transported 3,400 salmon eggs from Reynivellir to Thingvellir, to finish the hatching there, and plant the fry in the lake of Thingvallavatn, so as to see if the salmon (*Salmo salar*) could live in this lake. The temperature during transportation was very low, being at —17° C. [1.4° F.], but few eggs died.

During the same winter (1884–'85) an attempt was made to have a hatchery for mountain trout (*Salmo alpinus*) established at Thingvellir. Mr. Johanson went there on October 5 and impregnated about 10,000 eggs, which were placed in a wooden box 36 inches long, 16 wide, and 11 deep. They were kept in a cold spring, there being no hatching-house. On October 28 nearly 10,000 eggs more were impregnated and placed in a similar box. At first very few died; but on November 11 there was a heavy rain-fall with a high southerly wind, which caused inundation. The contents of one box were entirely destroyed, while those of the other suffered slightly by an overflow from the Oxará River. On December 24 the eyes of the embryos were first seen; in the middle of February hatching began, and it was completed by the end of the month; so the period of incubation lasted from one hundred and thirty to one hundred and forty days. Very few of the young fish died; and on April 29 all the fry, amounting to about 7,000, were planted in the Oxará River, connected with the lake of Thingvallavatn.

Most of the salmon eggs brought over from Reynivellir hatched, and the fry were deposited in the lake of Thingvallavatn on May 9. These were the first salmon in this lake. A year later one salmon was caught weighing one pound, but no others have been seen.

The lake of Thingvallavatn is the largest in Iceland, as it is from 4 to 5 square miles* in area; and its northern part is 70 fathoms deep. The bottom consists partly of sand and gravel, but mostly of lava, as it is formed by volcanic eruptions. Around it is a great tract of lava and range of craters. Considerable animal life and vegetation are found in it. Trout (*Salmo trutta*) in this lake grow very large, up to 20 and 22 pounds; while mountain trout in several varieties reach the weight of from 1 to 7 pounds. Many trout are caught in this lake at all seasons; during the winter numbers being hooked through the ice.

Mr. Johanson, after superintending this hatching in the winter season of 1884-'85, returned to Sweden. Since then the work at Reynivellir and Thingvellir has been kept up very poorly. In 1885-'86 about 6,000 eggs were hatched at Reynivellir; and in 1886-'87 somewhere between 9,000 and 20,000 eggs were hatched. At Thingvellir a few thousand eggs have been hatched each season. A third attempt to establish a hatchery was made in the autumn of 1886 at Hjardarholt in Dalir, where several thousand eggs were hatched. All of these hatcheries are insignificant and badly managed. They have no suitable apparatus for such work, not a tank nor box being on hand for the transportation of fry or spawning fish. Last spring 2,000 salmon fry were brought from Reynivellir to Thingvellir in a pail. The young fish were said to be living on reaching Thingvellir, but they were not transferred to the Lake of Thingvallavatn that day, and being left in the hatching-trough over night, in the morning all were dead. The hatching-boxes are unserviceable for hatching; it is not possible to breed the fry successfully in such apparatus as there is; and there are no basins for rearing the young fish. Consequently, the fry are turned out into the rivers and lakes before they have entirely consumed their yelk-sacks, and this probably results in the death or destruction of a great part of them, especially as sudden changes of temperature frequently occur in the water about this season from the presence of ice in the rivers. Then, too, animal and vegetable life has not yet roused from its winter sleep, so as to supply these fry with their needed food. It is therefore my opinion that at present the hatcheries, under the circumstances, are of very little use. It would be much better if the hatcheries were properly situated in Iceland, as many rivers are suitable for salmon and trout.

---

* Danish square miles, which would make its area about 100 English square miles.

Natural circumstances have at many places destroyed the fishing without any intervention of man. In autumn frequently heavy rains occur during the spawning season, and the rivers increase in volume and tear up their beds, while early in winter the streams freeze unexpectedly, thaw suddenly, and the ice sometimes changes the whole beds of the rivers, especially where they consist of sand and gravel. In those parts of the country where the river-beds are of lava formation the spawn may be saved from destruction by the holes and heavy rocks. Thus the fisheries in these rivers are preserved; but natural hardships and bad methods of fishing prevent the increase of salmon in the rivers, and almost entirely stop the fishing in many of them. Most of the fishing in Iceland is done during the spawning season of salmon and trout; and formerly dams were built across the streams where possible. In 1876 a law was introduced that nobody be permitted to capture any salmon later in the year than September 15, or to obstruct any river; but nothing was said about trout.

In all the large rivers salmon are caught in wedge-shaped nets, which are set in the rivers and on the places where the water is quiet. They are fastened in place either by stone-piles built out into the stream from the shores or by means of large baskets loaded with stones. In the smaller streams salmon boxes are used of different sizes. They are triangular in shape and made of wooden rails. One angle points up the stream, and the rails composing the sides of this angle are arranged horizontally, while the rails on the opposite side are perpendicular, with an opening between them for the entrance of the salmon. In many of the little rivers salmon are caught by means of sharp iron hooks attached to poles. Hauling-nets are used in all rivers, especially in their mouths and across them, in which the fishermen catch all salmon, large and small.

The trout are taken by means of set nets, drag-nets, and trout-boxes. All nets for trout have too small meshes, and catch even the smallest fish. They are badly made, ill fixed, and of very little worth. Often white bones are used on these nets as sinkers, as also on the salmon nets, which tend to drive the fish away. In lakes fishing-lines are used.

Many wealthy salmon-fishermen come to Iceland annually and rent the salmon rivers for a year or a period of years. They fish with hooks, staying in Iceland from the beginning of June to about the middle of September. The salmon which they catch and do not use are generally given to the neighboring farmers, who thus sometimes get both fish and rents. In 1876 and 1877 an Englishman (Mr. Richy) was in the southern part of the island and did a considerable business in putting up and exporting canned salmon.

The attention of the legislative assembly was not specially directed to this matter of protecting the fisheries, nor were laws enacted on this subject before 1885; and the present laws are in many instances primitive, imperfect, and inconvenient, according to the conditions of the country. One of the worst features is that in regard to seals, which are so injurious to the salmon fisheries. This is contained in section 4 of the following statute. The defective point about this bit of legislation is that in all salmon rivers (with one exception) and their mouths, where there are seals, there are also seal-catching places; so that the law is of little or no benefit to the salmon, as it is forbidden to disturb the seals in the places where they are at all easily accessible. The statute referred to was passed February 19, 1886, and is as follows:

"SECTION 1. It is unlawful to catch salmon in the sea, or in rivers or lakes, except during three months each summer. The county board shall in each jurisdiction fix definite rules as to the beginning and end of the fishing for that locality. During the season the salmon shall be entirely protected for thirty-six hours each week, from 9 p. m. Saturday to 9 a. m. Monday, during which time all salmon nets shall be taken up and all fishing apparatus be kept open, so that the salmon may have free passage. Nets so constructed that the salmon can not be entangled therein are to be considered as a fixed mechanical fishing apparatus.

"SEC. 2. It is illegal to set nets, dikes, or any other fixed fishing apparatus in a river farther out from the bank than the middle of the river; and even this is allowed only if the other half of the stream is no less deep than the half through which the dike, etc., extends. If it is desired to set nets, or have dikes or other apparatus extend from both sides of the river, there must be an interval of at least 30 fathoms of the length of the river between the apparatus extending from opposite sides. If there is only one owner of the fishing rights in a river, he is allowed to use cross-dikes; but if the river has affluents or separate arms, he is allowed to cross-dike only one of those arms, and this only when the setter of the dike is sole owner of the fishing right in that arm and when the salmon go in greater numbers up the other arms.

"SEC. 3. No one may set nets or other fishing apparatus out in lakes, or in the sea near the mouths of salmon rivers, in such a manner that the passage of the salmon is obstructed. It is allowed to use drag-nets in rivers only between 9 a. m. and 9 p. m., and in river mouths only before the shoaling of the fish at every other flood tide. Salmon may be caught by means of rods and lines, but not by stabbing instruments or spears. For scientific or breeding purposes salmon may be taken at any time of the year.

"SEC. 4. In rivers and their mouths where there are salmon, it is allowed to shoot or frighten seals with the restriction that the inviolability of breeding and seal-catching places, which are thus especially proclaimed, must not be infringed upon, except with the penalty of full damages, according to the estimate of good men nominated by the judge and sworn in court.

"SEC. 5. No fishing apparatus may be used which will catch small salmon. Meshes in a salmon net, when wet, must have a circumference of at least 9 inches. No nets may be double. In every apparatus there must be openings so large that salmon not measuring more than 9 inches in greatest circumference can not be detained therein. If the apparatus is provided with grates, the rails must be perpendicular with intervals of at least 1½ inches.

"SEC. 6. If the majority of the owners of the fishing right in any river wish the fishing to be carried on by all the owners jointly in order to protect the salmon better than according to the provisions of the present act, they must submit the case to the county board. If this board is of the opinion that no one's rights will be infringed, it may enact rules for the mode of fishing and the division of the catch, which rules shall be binding upon all persons concerned. In such cases the main river and its tributaries are to be considered as one river.

"SEC. 7. If local circumstances make it necessary to have more definite regulations than are provided for in the present act, one or more county boards may make additional regulations; but such regulations must in no way interfere with the principles of the present act warranting the free passage and protection of salmon. Such regulations, as well as those named in section 6, must have the sanction of the provincial governor, and be then valid as law for the next ten years after they are made.

"SEC. 8. Transgressions of this act are punishable by a fine of not more than one hundred crowns ($26.80), while all the unlawful catch and all unlawful apparatus may be confiscated."

The tables that follow show the amounts of salmon exported from Iceland, going chiefly or entirely to Denmark, the bulk of the export being salted and of not great value for exportation. There are no regular smoke-houses in Iceland, so the little smoking of fish that is done is carried on in the kitchens in a primitive manner. Canned salmon and salmon packed in ice are also exported in small quantities.

TABLE I.—*Exportation of salted salmon from Iceland to Denmark.*

[The pounds in the following tables are all Danish. One Danish pound = 500 grams about 1.1 English pounds avoirdupois.]

Place from which exported.	1630.	1743.	1784.	1806.	1816.	1849.	1855.	1858.	1859.	1861.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Husavik[1]						4,800	5,712	2,368	6,400	
Akureyri[1]										
Siglufjördur[1]										
Sandárkrókur[1]										
Blönduós[1]								2,384		
Skagaströnd[1]										
Reykjavik[2]						480	480			
Eyrarbakki[2]										
Akranes[2]										
Bordeyri[3]								448		19,080
Stykkishólmur[3]								672		
Brakarpottur[3]										
Isafjördur[3]										
Total[4]	5	3	17	28	104	5,280	6,192	5,872	6,400	19,080

TABLE I.—*Exportation of salted salmon from Iceland to Denmark*—Continued.

Place from which exported.	1864–5.	1866.	1867.	1868.	1869.	1870.	1871–2.	1873.	1874.	1875.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Husavik[1]	414	896	3,808	2,816	3,808	2,464	10,304	34,650	22,550	1,750
Akureyri[1]										
Siglufjördur[1]										
Sandárkrókur[1]										
Blönduós[1]		6,720	18,620	324	1,344	1,904	6,944			
Skagaströnd[1]								9,714	8,679	5,743
Reykjavik[2]	3,912	2,016	1,312	896	2,464	61,376	18,144	28,875	22,200	22,750
Eyrarbakki[2]									215	7,525
Akranes[2]										
Bordeyri[3]	448	1,120	2,016		448	179,648	1,568	4,950	4,675	3,300
Stykkishólmur[3]										
Brakarpottur[3]										
Isafjördur[3]										
Total	4,774	10,752	25,756	4,036	8,064	245,392	36,960	78,189	58,319	41,068

Place from which exported.	1876.	1877.	1878.	1879.	1880.	1881.	1882.	1883.	1884.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Husavik[1]	19,600	12,200	6,000	846	1,060	7,648	858	4,530	919
Akureyri[1]						230			
Siglufjördur[1]			100						
Sandárkrókur[1]		400							
Blönduós[1]	2,000	3,000	1,227			10,737	724	1,354	362
Skagaströnd[1]	8,120	5,121	1,286	564	3,688	7,598			
Reykjavik[2]	21,400	16,800	32,022	1,787	2,028	14,264	20,227	705	28,866
Eyrarbakki[2]	9,400	9,200	15,162	2,823	12,073	21,108	23,853	4,760	3,563
Akranes[2]									3,774
Bordeyri[3]	1,732	3,400	700		2,011	2,866		541	283
Stykkishólmur[3]									
Brakarpottur[3]		33,513						3,000	4,770
Isafjördur[3]	800								
Total	63,052	83,634	56,497	6,020	20,860	64,451	45,662	14,890	42,537

[1] In north part of Iceland.
[2] In south part of Iceland.
[3] In west part of Iceland.
[4] No place of exportation is assigned for the first five totals.

TABLE II.—*Exportation of other preparations of salmon from Iceland.*

Place from which exported.	Canned.			Smoked.			Ice-packed.
	1876.	1877.	1880.	1877.	1880.	1883.	1877.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
Reykjavik	20,038	28					3,207
Akranes	22,600						
Siglufjördur			419				
Stykkishólmur				140			
Blönduós					1,664		
Bordeyri						162	

REYKJAVIK, ICELAND, *September* 20, 1887.

BRYANT WALKER LIBRARY
MUSEUM OF ZOOLOGY
UNIVERSITY OF MICHIGAN

40.—NOTES ON THE USE OF SQUID FOR FOOD IN THE UNITED STATES.

By J. W. COLLINS.

Much change is being brought about in the American markets in the matter of the utilization of marine products for food, and apparently this is, in a measure, due to the aggregation of people of foreign birth in the more important coast cities. The most remarkable innovation in the direction of the utilization of sea products for food which has recently come to my knowledge, is that of the demand for squid (chiefly *Loligo pealei*) for food in New York markets, where this species is sought and apparently highly appreciated by the Italians, of whom there are large numbers residing in New York City.

Mr. E. G. Blackford states that the demand for squid has been constantly increasing for the past four years, and this branch of the trade is becoming a profitable one. "The entire consumption," he says, "appears to be by the Italians. I have known of as much as 4,000 pounds being received from Long Island and sold in one day. The demand is steady, and if the squid are in good order they are readily sold at from 3 to 6 cents per pound. When properly cooked the squid is a most excellent dish."

Mr. Blackford thinks that the influence of the Ichthyophagous Club of New York has had much to do with the introduction of squid for food, and says that about three or four years ago the club first ventured to cook and serve squid at one of their annual dinners. It is a well-known fact, however, that squid are highly valued for food in Oriental countries, and that an important fishery for them is carried on in China. It is also probable that the Italians, who are the consumers of this product in New York, learned to eat squid in their native country, before emigrating to America.

Mr. Atkins Hughes, of North Truro, Mass., who is engaged in the trap fishery at that place, makes the following statement in regard to the demand for squid:

"When in New York the past three or four years I was told that the Italians used squid for food, but that the quantity was small and the price low. Very little encouragement was given me to ship until the past season (1887), when a fish dealer in the Fulton Market said to me, about October 1: 'If you can ship me a few barrels of squid occasionally I think I can sell them at a low price.' The squid season was nearly over then, but in looking over my books I find that we shipped to dealers in New York about 50 barrels in 1887, which sold from 2 to 5 cents per pound, netting about $3 per barrel."

Under date of December 2, 1887, he says: "The squid season is about over. Some days we have a few bushels in our weirs, but they have become such an article of food among the Italians of New York that we can obtain better prices by shipping them there, than by selling them for bait."

From the foregoing, it would appear that with the increase of population in this country and with a better knowledge of the food value of certain species of marine animals which have heretofore not come into general use, it is supposable that the food supply from our ocean fisheries can be very considerably increased. Some species of fish that are held in the highest esteem in Europe, and which occur in the greatest abundance off our coasts, are seldom or never eaten by Americans, and there is practically no demand for them in our markets. Perhaps the most noted of these is the Skate (*Raia*), while many species of the flatfishes—flounders, dabs, etc.—are so little prized that their capture is a matter of minor commercial consequence.

WASHINGTON, D. C., *April* 20, 1888.

41.—NOTE ON THE OCCURRENCE OF MACKEREL OFF THE COAST OF FLORIDA.

By J. W. COLLINS.

Capt. John W. Emmons, master of the schooner *Belle of the Bay*, of New London, Conn., recently arrived in New York from a winter's fishing cruise for Red Snappers on the grounds off of Cape Canaveral, Florida. He fished in that region from December 12, 1887, to April 14, 1888. In a conversation which I had with him three days ago, he stated that during January of the present year he saw several schools of mackerel in the vicinity of Cape Canaveral, but chiefly about 15 to 25 miles southeast from the cape, and that as many as one hundred specimens of the fish were caught by his crew on the fishing gear used for the capture of Red Snappers. These mackerel were from 12 to 15 inches in length. The captain is confident that they were all of the common species, *Scomber scombrus*.

Although he frequently saw schools of mackerel, he is of the opinion that purse-seines could not be used because of the abundance of sharks, which would tear the nets to pieces.

WASHINGTON, *April* 25, 1888.

Vol. VII. Washington, D. C. May 12, 1888.

42.—REPORT ON THE FISHES OBSERVED IN GREAT EGG HARBOR BAY, NEW JERSEY, DURING THE SUMMER OF 1887.

By TARLETON H. BEAN.

Ichthyologist, U. S. Fish Commission.

In the summer of 1854 Prof. Spencer F. Baird, then Assistant Secretary of the Smithsonian Institution, spent a period of six weeks on the coast of New Jersey, principally at Beesley's Point and Long Island, New York, "studying the habits and distribution of the principal species of fishes that are known on that portion of our shores during the summer." Professor Baird took 67 species, and in his report to the Secretary of the Smithsonian Institution, which was printed in the Ninth Annual Report of the Institution for 1854, he gives descriptions of colors taken from the fresh and living fish, notes on the natural history and distribution of many of the economic species, and the vernacular names employed by the fishermen of the bay. He gives, also, a description of the physical features of the region explored. In this report the following new species are described: *Pomotis chætodon*, *Centrarchus pomotis*, *Lobotes emarginatus*, *Eucinostomus argenteus*, *Hydrargyra luciæ*, and *Cyprinodon parvus*, all of which, except one, are still regarded as valid.

This was the first systematic account of marine fishes made by Professor Baird, and it is the only one of the kind which has emanated directly from his pen. It was here that he originated the methods of observation of marine fishes which were long afterwards applied in his greater researches on behalf of the United States Government into the causes of the decrease of food-fishes and their propagation in the waters of the United States.

In the spring of 1887 Professor Baird expressed a desire to have the writer undertake a new exploration of the waters of Great Egg Harbor Bay with the view of discovering what changes had taken place in the fauna during the long interval since 1854. In accordance with this wish I was directed to go to that region in July, 1887, to make collections and observations. Finding that Beesley's Point is remote from railroads and without telegraphic communication I decided to make my headquarters at Somers Point, on the opposite side of the bay and several miles distant. I was assisted in my work by Mr. L. M. McCormick, of Oberlin College, Ohio, who remained at Somers Point from August 20 to September 9. I am indebted also to Mr. Bolton E. Steelman, whose skill in navigation and in the details of fishing aided me materially.

The localities mentioned by Professor Baird, with one or two exceptions, notably the Cedar Swamp Creeks and Corson's Inlet, were visited by us many times during our seining trips, which were continued during all of August and the first half of September. We had no interruptions on account of bad weather. Our seines proved effective in taking 86 species. It would have been better, however, had we taken with us a seine of 60 or 70 fathoms in length and about 15 feet deep in the bag. Our largest seine, 20 fathoms long, greatest depth 10 feet, proved too small for the capture of skates, sting rays, and sharks.

There have been many changes in the bay since 1854. One of the ocean inlets which was then navigable for moderately large vessels is now closed and its site is occupied by the town of Longport. New islands have formed, channels have shifted, and the number of algæ has apparently increased.

Some of the species found in abundance by Professor Baird were not seen by us and upwards of 30 species which were not recorded in his report we found during the last summer. The sheepshead was not taken in 1854; it is not abundant now, but adults are occasionally caught with the hook, and the young were found in moderately large numbers by us at Beesley's Point. On the other hand, young drum were found to be abundant by Professor Baird, but the species was not obtained by us. The young *Lutjanus* is another species which we did not see at all.

Following is a complete list of the species which are recorded by Professor Baird and not obtained by us: *Chilomycterus fuliginosus*, *Ophidium marginatum*, *Pogonias chromis*, *Lutjanus griseus*, *Enneacanthus obesus*, *Mesogonistius chætodon*, *Esox americanus*, *Fundulus luciæ*, *Opisthonema oglinum*, *Ælurichthys marinus*, and *Reniceps tiburo*.

Ophidium marginatum does not occur in the bay in summer. *Cottus octodecimspinosus* has been taken in November. *Pogonias chromis* is still taken occasionally by the purse-seiners in the ocean near by. We made special effort to find *Fundulus luciæ* in the ditches at Robinson's Landing, near Ocean City, but the extensive changes in the drainage system of Peck's Beach seem to have driven away that species. *Opisthonema oglinum* still inhabits the region and will doubtless be found again. The sea catfish, *Ælurichthys marinus*, seems to be unknown to the fishermen, and the only "shovel-nose shark" recognized now is not the true shovel-nose, but *Sphyrna zygæna* instead.

Other young fishes obtained by me are the following: *Astroscopus anoplus*, *Elacate canada*, *Orthopristis chrysopterus*, *Sphyræna picuda*, and *Tylosurus gladius*. Some of these have not previously been described.

Lagocephalus lævigatus, *Hippocampus punctulatus*, and *Fistularia tabaccaria* were found to be moderately common. *Menidia laciniata* was found abundant.

A day or two before my arrival at Somers Point, a cargo of 40,000 mackerel was landed there. These were taken by one of the menhaden steamers in the vicinity, and a few days later a fishing schooner took

10,000 off Squan, N. J. The mackerel landed at Somers Point proved to be *Scomber pneumatophorus*, and the catch off Squan was also reported to be "thimble-eye mackerel." Observation and inquiry into the occurrence of mackerel off this portion of the coast in July and August lead me to believe that *Scomber pneumatophorus* is the species taken at that period, and that *Scomber scombrus* probably does not occur so late in the summer.

Great Egg Harbor Bay has neither pounds nor traps. Seines were used during our stay, but this is contrary to law. Two factories for the making of fertilizers from the menhaden are located in this region. Three menhaden steamers make this bay their headquarters. They reported a fair catch of fish up to the middle of September, after which my investigations closed.

Fishing with hand-lines is very satisfactory. Large catches of weakfish and kingfish are made in this way during the summer. Gill-nets are used in winter, the principal yield being white perch. Shortly after the 1st of September the fish-eating birds disappeared suddenly and the fishing dropped off. At the time of my departure, September 21, the only good catches of weakfish were made in the ocean adjacent to the bay.

An attempt was made to use the trawl-line in the channels, but it was found to be unserviceable on account of the great masses of floating algæ with which the hooks became invested.

FISHES OF GREAT EGG HARBOR BAY, NEW JERSEY.

Species taken in 1887.	Species taken in 1854.
1. Chilomycterus geometricus	Chilomycterus geometricus.
2.	Chilomycterus fuliginosus.
3. Tetrodon turgidus	Tetrodon turgidus.
4. Lagocephalus lævigatus	
5. Monacanthus hispidus	
6. Alutera schœpfii	
7. Siphostoma fuscum	Siphostoma fuscum.
8. Hippocampus punctulatus	
9. Achirus mollis	Achirus mollis.
10. Citharichthys microstomus	
11. Pleuronectes americanus	Pleuronectes americanus.
12. Paralichthys dentatus	Paralichthys dentatus.
13. Bothus maculatus	Bothus maculatus.
14.	Ophidium marginatum.
15. Batrachus tau	Batrachus tau.
16. Astroscopus anoplus	
17. Gobiosoma bosci	Gobiosoma bosci.
18. Prionotus strigatus	
19. Prionotus palmipes	Prionotus palmipes.
20. Cephalacanthus volitans	
21. Cottus octodecimspinosus	Cottus octodecimspinosus.
22. Sparisoma	
23. Tautoga onitis	Tautoga onitis.
24. Ctenolabrus adspersus	
25. Gerres argenteus	Gerres argenteus.
26. Chætodon maculocinctus	
27. Sarda sarda	
28. Scomberomorus maculatus	Scomberomorus maculatus
29. Scomber pneumatophorus	
30. Caranx hippos	Caranx hippos.
31. Seriola zonata	
32. Selene gallus	Selene gallus.
33. Trachynotus rhomboides	Trachynotus rhomboides.
34. Trachynotus carolinus	Trachynotus carolinus.
35. Poronotus triacanthus	Poronotus triacanthus.

FISHES OF GREAT EGG HARBOR BAY, NEW JERSEY—continued.

Species taken in 1887.	Species taken in 1854.
36. Cynoscion regale	Cynoscion regale.
37. Menticirrus saxatilis	Menticirrus saxatilis.
38. Menticirrus alburnus	
39. Liostomus xanthurus	Liostomus xanthurus.
40. Bairdiella chrysura	Bairdiella chrysura.
41.	Pogonias chromis.
42. Stenotomus chrysops	Stenotomus chrysops.
43. Archosargus probatocephalus	
44. Lagodon rhomboides	
45. Orthopristis chrysopterus	
46.	Lutjanus griseus.
47. Acantharchus pomotis	Acantharchus pomotis.
48.	Enneacanthus obesus.
49.	Mesogonistius chætodon.
50. Centropristis furvus	Centropristis furvus.
51. Boleosoma olmstedi	
52. Boleichthys fusiforme	Boleichthys fusiforme.
53. Roccus americanus	Roccus americanus.
54. Roccus lineatus	Roccus lineatus.
55. Elacate canada	
56. Pomatomus saltatrix	Pomatomus saltatrix.
57. Aphredoderus sayanus	Aphredoderus sayanus.
58. Sphyræna borealis	Sphyræna borealis.
59. Sphyræna picuda	
60. Mugil curema	Mugil curema.
61. Mugil albula	
62. Menidia notata	Menidia notata.
63. Menidia laciniata	
64. Apeltes quadracus	Apeltes quadracus.
65. Fistularia tabaccaria	
66. Tylosurus marinus	Tylosurus marinus.
67. Tylosurus gladius	
68. Hemirhamphus roberti	
69. Esox reticulatus	Esox reticulatus.
70.	Esox americanus.
71. Melanura pygmæa	Melanura pygmæa.
72. Fundulus majalis	Fundulus majalis.
73.	Fundulus luciæ.
74. Fundulus heteroclitus	Fundulus heteroclitus.
75. Fundulus diaphanus	Fundulus diaphanus.
76. Cyprinodon variegatus	Cyprinodon variegatus.
77. Lucania parva	Lucania parva.
78. Synodus fœtens	Synodus fœtens.
79. Etrumeus teres	Etrumeus teres.
80. Clupea æstivalis	
81. Clupea mediocris	Clupea mediocris.
82. Brevoortia tyrannus	Brevoortia tyrannus.
83.	Opisthonema oglinum.
84. Stolephorus mitchilli	
85. Stolephorus browni	Stolephorus browni.
86. Stolepherus eurystole	
87. Erimyzon oblongus	Erimyzon oblongus.
88. Catostomus teres	
89. Notemigonus chrysoleucus	Notemigonus chrysoleucus.
90. Amiurus natalis	
91.	Ælurichthys marinus.
92. Conger conger	Conger conger.
93. Anguilla rostrata	Anguilla rostrata.
94. Raia eglanteria	
95. Raia lævis	
96. Trygon hastata	Trygon hastata.
97. Myliobatis fremenvillei	
98. Sphyrna zygæna	
99.	Reniceps tiburo.
100. Carcharias obscurus	Carcharias obscurus.
101. Mustelus canis	Mustelus canis.

1. **Chilomycterus geometricus.** (Mitchill). Cucumber-fish.

Diodon maculato-striatus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 351.

A young example, 3 inches long, was seined at Longport August 29. This is much less elongate than the adult and has the orbital tentacles greatly developed. The black spot which is present near the anal origin in the adult is absent in the young.

A large individual, 8 inches long, was given to me by Mr. Charles Clements, August 29; it was caught on a hook in the bay. The species is known as the the "Cucumber-fish" at Somers Point.

2. **Chilomycterus fuliginosus** (De Kay).

Diodon fuliginosus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 351.

Professor Baird records the capture of a few specimens in Great Egg Harbor River by means of a seine.

We searched diligently in the same locality, but failed to find the species.

I have not been able to discover the Beesley's Point examples in the National Museum.

3. **Tetrodon turgidus** (Mitchill). Toadfish.

Tetraodon turgidus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855,352.

The young are abundant everywhere about the shores of the bay. Numerous specimens were taken in the seine at Ocean City August 1, and at Beesley's Point August 10 and 11. Adult examples were several times caught on hooks baited for larger species. Two large specimens were seined in the grass at Beesley's Point August 10.

This species, called "toadfish" at Somers Point, has the same habit as *Lagocephalus lœvigatus* of inflating itself by means of air or water at will. By some persons it is considered excellent for eating.

4. **Lagocephalus lævigatus** (Linn.).

An individual 4¾ inches long was seined by Andrew Jeffries at Somers Point, August 27.

Two examples, one of which is 6 inches long, were seined in a thoroughfare near Somers Point, August 30.

A specimen 7 inches long was caught on a hook by Rees Boise, September 2.

An individual 6 inches long was caught on a hook September 4.

Two were seined at Beesley's Point, September 9; these are 6.3 and 7 inches long.

Four more were caught at the same place, September 10; these vary in length from 6 to 6½ inches.

One was hooked by Silas Boise, September 16, and another was caught in the same way on the 18th from one of the wharves.

This fish inflates its abdomen by pumping in air or water at will. It is unknown to the fishermen.

5. **Monacanthus hispidus** Linnæus.

Two individuals were caught in the seine at Ocean City, August 1. The larger is 3½ inches and the smaller 1¾ inches long. D. I, 33; A. 33.

Two examples were caught in a thoroughfare near Somers Point, August 30.

Another one was seined at Beesley's Point, August 23. This one has several parasites attached to the fins.

6. **Alutera schœpfii** Walbaum. Sunfish.

Found sparingly about the shores; no adults seen. Young examples were taken at Ocean City, August 1, and at Beesley's Point, August 11.

At Beesley's Point, September 10, an example 9¾ inches long was taken. Seiners occasionally catch this fish, and it may be found lying on the beach where the seines are landed.

The name "sunfish" is sometimes applied to this species at Somers Point.

7. **Siphostoma fuscum** Storer. Billfish.

Syngnathus viridescens BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 351.

Males, females, and young were abundant at Ocean City, August 4. The egg-pouches of the males are filled with eyed embryo, arranged in four series on each side.

The species was abundant August 1, also, at the same place. It is common everywhere, and both sexes occur, but the males are more numerous than the females.

A male 6½ inches long, taken near Ocean City, August 31, has the pouch unsymmetrically filled, the left side containing more than two-thirds of the whole quantity of embryos and increasing in carrying capacity from behind forward.

This is called "billfish" at Somers Point.

8. **Hippocampus punctulatus** Guichenot. Horsefish.

Two males and three females were seined at Ocean City, August 1. The pouches of the males are much enlarged, but not yet dehiscent. Dorsal of the ♀ with a yellow margin; of the ♂ with orange. In both sexes there is a submarginal dark band. A dark blotch at top of anterior dorsal rays in both sexes. Cirri more developed in one of the females than in any of the other examples. One of the males has body rings vertically striped with narrow, dark brown stripes. All have several linear stripes obliquely across opercles from eye, and usually two on the neck. Abdominal edge dark. One female has wider stripes on the throat, converging behind, flanked in front by a few irregular dark blotches, and behind by four interrupted lines. White punctulations most numerous posteriorly.

August 23, 6 adult specimens, 2 of them males, were seined in one of the thoroughfares in the bay. The pouches of the males are well distended with embryos.

August 31, 4 adults, 2 males and 2 females, were seined in a thoroughfare near Ocean City. The males had the pouches fully distended. Both sexes have cirri greatly developed.

A male seined at Somers Point, September 5, has the pouch empty and the anal fin well developed; the cirri are all absent also.

9. **Achirus mollis** Mitchill.

Achirus mollis BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 350.

No young examples have been taken, and the adults are not common. Specimens were seined at Ocean City, August 1, and at Beesley's Point, August 10 and 11. One was caught at Somers Point, July 29. The species was observed to be rather more abundant near Great Egg Harbor River than in other parts of the bay.

10. **Citharichthys microstomus** Gill.

Four examples were seined at Ocean City, August 1. D. 74; A. 55; scales, 41–42.

One of these, a specimen about 3 inches long, is dextral; all the rest are sinistral, as usual. I have not seen a dextral example before.

Young examples were seined, August 13, at Somers Point.

We find the species everywhere in moderate numbers. One was caught at Ocean City, August 25. In a thoroughfare near Ocean City, August 31, we took some large individuals, and smaller ones were moderately abundant; the largest is 4½ inches long.

Examples from 2 to 2½ inches long were caught at Beesley's Point, September 10.

11. **Pleuronectes americanus.** Walbaum. Winter flounder.
Platessa plana BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 349.

Half-grown and young individuals were seined at Ocean City, August 4. Other examples were seen at Beesley's Point a week later.

Young examples were found abundant in thoroughfares near Somers Point, August 30. From this time forward to the middle of September we seined the "winter flounder" in small numbers, but took no adults.

12. **Paralichthys dentatus** (Linnæus). Summer flounder.
Platessa ocellaris BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 349.

Small and large individuals were seined at Ocean City, August 1. The species is common everywhere, but no very young examples were seen. It takes the hook freely and is prized for food.

The gill-rakers are uniformly 20 or 21 in our specimens.

The species is known at Somers Point as the "summer flounder."

13. **Bothus maculatus** (Mitchill). Window-light.
Rhombus maculatus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 350.

A single small example of the "window-light" was seined by Capt. Thomas Steelman of the menhaden steamer *Nellie Rawson.* We have not found the species in the bay, notwithstanding diligent search made for it. Professor Baird found it occasionally in the surf in 1854.

14. **Ophidium marginatum** De Kay.
Ophidium marginatum BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 351.

This species was not taken by Professor Baird in summer; his specimen, which is still preserved in the National Museum, was taken during the winter of 1853–'54 by Mr. Chatten.

15. **Batrachus tau** Linnæus. Oyster-fish.
Batrachus variegatus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 340.

Seined at Ocean City, August 1, and everywhere about the shores. It is particularly common at Beesley's Point, near the river mouth.

Anglers for weakfish frequently catch the toadfish instead, much to their disgust. No very young examples have been seen. The species is usually called "oyster-fish" at Somers Point.

16. **Astroscopus anoplus** Cuv. and Val. (Pl. I, figs. 1 and 2.)

A single young individual, 1 inch long, was seined at Ocean City, August 1. The species has not previously been recorded from this bay.

Another example, 2½ inches long, was caught at Longport, August 26, not far from the inlet. The colors of the specimen, August 28, are as follows: Top of head, cheeks, sides, and a narrow strip along dorsal bases, plum color; back, olive; lower part of head, belly, ventrals, anal, and soft dorsal, whitish; caudal, pale, with a faint yellow blotch at base and a dusky streak on middle portion; spinous dorsal, black; chin with a yellow T-shaped marking, the stem of the T bounded on each side by a wing-shaped blotch of purple, which has a dark inner edge; pectoral, plum color, its lower margin whitish. D. IV, 14; A. 13. A prominent anal papilla. A low fold of skin extends from the ventrals along the median line of the belly to the anal papilla. Two slight furrows between the eyes, with two rows of papillæ along their inner margins. Behind these furrows are naked spaces, little developed, but quite distinct. Nostrils surrounded by a row of papillæ.

17. **Gobiosoma bosci** (Lacépède).

Gobius alepidotus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 339.

Three individuals were taken in the seine at Somers Point (Lousy Harbor), August 13. This species was found by Professor Baird rarely at Beesley's Point in 1854. It is common in Great South Bay, Long Island, and in Buzzard's Bay.

Two examples were seined in a thoroughfare near Somers Point, August 30.

Several specimens were seined, September 16, in ditches at Robinson's Landing, Ocean City, in company with *Fundulus*, *Cyprinodon*, *Lucania*, *Menidia*, *Mugil*, *Bairdiella*, *Anguilla*, and hosts of shrimp.

18 **Prionotus strigatus** Mitchill. Flying-fish.

Young specimens were seined at Beesley's Point, August 10. A single adult was given to me, August 13, by Capt. Frank Steelman. This was caught on a hook in the bay.

Young examples were taken again at Beesley's Point, September 9.

19. **Prionotus palmipes** Storer. Flying-fish.

Prionotus pilatus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 327.

Common everywhere. This species is readily distinguished from the striped sea robin by its black branchiostegal patch and the absence of lateral stripes.

The species is known at Somers Point as the "flying-fish."

20. **Cephalacanthus volitans** (Linnæus).

A single example, 2½ inches long, was seined at Ocean City, August 1.

A second specimen, 6½ inches long, was seined in a thoroughfare near Ocean City, August 31.

Another example, 7.7 inches long, was taken at Beesley's Point, September 9.

21. Cottus octodecimspinosus Mitchill.

Acanthocottus virginianus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 328.

This species does not come into Great Egg Harbor Bay in summer. Professor Baird's dried specimen was secured by Mr. Ashmead in winter.

A fine, large example, 12 inches long, was caught at Somers Point in November, and presented to the Museum by Mr. W. H. Keates.

22. Sparisoma sp.

A small individual of a species of *Sparisoma*, 2.1 inches long, was taken in the seine, September 15, near the mouth of Lousy Harbor, Somers Point.

Colors after immersion in alcohol over night: Body, greenish olive, except on abdomen and under surface of head, which are whitish, washed with yellow; dorsal, anal, and pectoral fins, pink, speckled with brown; a broad, light-brown stripe on tip of lower jaw; two similar stripes on cheeks, one of which extends from below the eye obliquely downward and forward; caudal with four badly-defined brown cross-bands; a pale band along the median line and another on the lateral line.

Scales, 2½–24–6.

Teeth anchylosed, but with free conical tips in both jaws. Gill-membranes attached to the isthmus.

23. Tautoga onitis (Linnæus). Smooth blackfish. (Pl. III., fig. 3.)

Tautoga americana BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 340.

Two individuals were taken on hand-line at Somers Point, August 8, with fiddler-crab bait. The larger example was about 10 inches long and the smaller about 7 inches.

The young are abundant at Beesley's Point and at Somers Point. Many examples were caught at Beesley's Point, August 10 and 11, the smallest being 1 inch long. Large individuals are taken with hooks in company with *Centropristis* and *Archosargus* in the vicinity of submerged wrecks.

The species is called "smooth blackfish" at Somers Point.

24. Ctenolabrus adspersus (Walbaum). Bengal.

A single example, 4¼ inches long, was seined at Beesley's Point, August 11, in the grass near the river mouth. The species is called "bengal" at Somers Point, probably a corruption of bergall.

The young were found near the boat-landing at Somers Point, August 20. An example, 1⅗ inches long, was seined at Beesley's Point, August 23.

An individual, 3¼ inches long, was seined in a thoroughfare near Somers Point, August 27, in a muddy hole.

An example, 5 inches long, was seined at Beesley's Point, September 9, and numerous individuals were obtained at Somers Point, September 16.

25. Gerres argenteus (Baird & Girard).

Eucinostomus argenteus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 335.

Numerous young individuals were seined at Beesley's Point, August 10 and 11, and near Somers Point, August 13. No adults were taken.

The young were obtained again at Ocean City, August 16.

The species is found almost everywhere. We took it, August 27, in a muddy hole in one of the thoroughfares near Somers Point.

26. Chætodon maculocinctus (Gill). (Pl. I., fig. 4.)

A single individual, 1¼ inches long, was taken in the seine at Beesley's Point, September 2.

The general color of the sides was yellow, more persistent in alcohol on the ventral surface and caudal peduncle than elsewhere.

D. XIII, 20; A. III, 18; lateral line, 45; third and fourth dorsal spines equal, and as long as the head without the snout.

27. Sarda sarda (Bloch). Bonito.

A half-grown individual was caught off Ocean City by Capt. Thomas Steelman, of the menhaden steamer *Nellie Rawson.*

The species is known as "bonito" at Somers Point.

28. Scomberomorus maculatus (Mitchill).

Cybium maculatum BAIRD, Rep. Fish. N. J., 1855, 21; Ninth Ann. Rep. Smith. Inst., 1855, 335.

Professor Baird records two specimens taken during his stay at Beesley's Point, and states that the species was scarcely known to the fishermen. The species is occasionally met with by the menhaden seiners off this portion of the coast, but we failed to obtain a specimen in our seines.

A single specimen, 11¾ inches long, was caught in a purse-seine by Capt. Thomas Steelman, of the steamer *Nellie Rawson*, after my departure from Somers Point.

29. Scomber pneumatophorus De la Roche. Mackerel.

The Philadelphia Press, newspaper, of July 24, contains an account of the capture of about 50,000 mackerel by the menhaden steamer *A. Morris*, near Ocean City, July 19.

The Philadelphia Record, newspaper, of July 27, records the capture of 6,000 thimble-eye mackerel, July 25, by the fishing schooner *Peter Cooper*, off Squan, N. J.

Some of the mackerel caught by the steamer *A. Morris* were preserved in brine by W. B. Steelman. Upon examination I found them to be *S. pneumatophorus.* The species is said to arrive usually in August.

William Jeffries & Sons, dealers in fish and oysters, Indiana avenue, Atlantic City, stated to me that no mackerel have come into their market during the present summer from fishermen. The only catches they know of are those made by the menhaden steamer *A. Morris*, and by a vessel off Squan. Last summer they were caught frequently.

30. Caranx hippos (Linnæus).

Caranx chrysos BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 336.

An example, 3½ inches long, was taken at Beesley's Point, August 11, 1887.

Caudal, yellow; basal half of elevated portion of anal, yellow; cheeks and lower half of sides also yellow; a black opercular spot, but none on pectoral; several narrow pale bars on sides; tip of elevated part of soft dorsal, dusky; membrane between dorsal spines, dusky; iris, copper color.

A second specimen, 4 inches long, was seined at Ocean City, August 16. This example when held in the hand made a sound resembling that produced by the young hogfish.

Two examples, 3¼ to 3¾ inches long, were seined at Beesley's Point, August 23. Still another, 6¼ inches long, and showing the black pectoral blotch, was taken at Longport, August 29; this one made a very distinct croaking sound when taken in the hands.

31. Seriola zonata (Mitchill). Shark's pilot.

A "shark's pilot," about 8 inches long, was caught off Longport, in August, by Capt. Thomas Steelman, of the steamer *Nellie Rawson*. The species was not found in the bay. After my departure Captain Steelman caught two more examples, the larger one measuring 10¾ inches.

32. Selene gallus (Linnæus).

Argyreiosus capillaris BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 337.

Beesley's Point, August 10 and 11.

Silvery. Five golden bands on sides, one of which extends through the eye and below it half way to maxilla, or slightly farther. The second and third soon fade, persisting only above median line and at their lower extremities.

The example taken August 11 is 4 inches long; its longest first dorsal ray measures 6⅞ inches; the other is 3 inches long, and has a filamentous spine measuring 5 inches.

Another individual was seined September 16

33. Trachynotus rhomboides (Bloch). (Pl. III., fig. 5.)

Lichia spinosa BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 336.

Five young individuals, from 1 inch to 1¾ inches long, were seined at Beesley's Point, August 10 and 11.

After immersion in alcohol several days the colors are the following: General color, silvery, thickly sprinkled with dusky; sides wholly or partly suffused with pink; ventrals and tip of anterior anal rays orange; dorsal and anal dusky, with a narrow, pale marginal band; caudal, milk white, the lower lobe faintly tinged with yellow; iris, pink.

The young were abundant again at Longport, August 26, in the surf.

Several young, the largest 2¼ inches long, were seined at Beesley's Point, September 9.

An individual, 1½ inches long, taken at Beesley's Point, September 2, was mainly silvery when seined, but on being placed in a small aquarium almost instantly became dark brown, the dorsal and anal nearly black. On the ventrals, the anal spines, and the anterior tip of the anal fin, the usual vermilion, shading into orange.

34. **Trachynotus carolinus** (Linn.).

Lichia carolina BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 335.

An example, 4¼ inches long, was seined in the surf at Longport, August 26, the only specimen seen up to that date.

Another individual, 5¼ inches in length, was seined at the same place, September 8.

35. **Poronotus triacanthus** (Peck).

Peprilus triacanthus BAIRD, Rep. Fish. N. J., 1855, 24; Ninth Ann. Rep. Smith. Inst., 1855, 338.

Professor Baird secured several specimens which were caught in a net at Corson's Inlet, and saw small schools swimming close to the steep banks. Although the species is known to the fishermen, and is said to be present in summer, we did not see a single individual.

Two examples were seined by Capt. Thomas Steelman, however, after my departure from Somers Point; these are from 6 to 8½ inches long.

36. **Cynoscion regale** (Bl. Schn.) Weakfish. (Pl. II, fig. 6.)

Otolithus regalis BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 329.

The young are abundant everywhere. The smallest example seined is 1¼ inches long. Weakfish weighing 2 or 3 pounds are not often taken in the bay at this time; the average of the numerous individuals hooked is below 1 pound. Large fish are caught in April and May, but they are said to leave before the spawning season arrives. August 15, the catch of weakfish is very large, some boats taking 150 on a tide.

At this date, September 9, and for some days before, we have seen very few young weakfish. A single one, 4 inches long, was seined at Beesley's Point. The catch of weakfish in the bay has fallen off to nearly nothing. Two young, 3 inches long, were caught in a thoroughfare near the draw-bridge, September 10.

When the fishing ended in the bay it begun outside in the adjacent ocean. On the 19th of September one boat took 101, but all of them were small, the average weight being about one-third of a pound. On the same date a single example of *C. maculatus* was caught in the bay, at Jimmy's Island.

On September 20 the yield from three boats was 29, 103, and 150 weakfish. On the 21st a single boat containing two men brought in 200 fish, many of which were large.

37. Menticirrus saxatilis (Bl. Schn.). Kingfish. (Pl. II, III, figs. 7 and 8.)
Umbrina albur nus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 331.

Numerous young examples were seined at Ocean City, August 1, and at Beesley's Point, August 10 and 11. They are abundant everywhere. The adults are plentiful also, especially near sand-bars.

Half-grown individuals were taken August 23 in one of the thoroughfares near Somers Point; these vary from 3⅝ to 5½ inches in length.

Two adults were caught at Longport, September 8. Half-grown individuals, 6½ inches long, were seined at Beesley's Point, September 9 and 10. Anglers catch very few of this species now (September 10).

The name of this species at Somers Point is "kingfish."

38. Menticirrus alburnus (Linnæus). Kingfish.

Apparently not common. The second example so far recognized by me as belonging to this species was caught with a hook in the bay, August 23; it is 12 inches long. D. X, I, 23; A. I, 7. The longest dorsal spine is one-half as long as the soft dorsal and two-thirds as long as the head.

This is known as "kingfish," and is apparently not recognized as a species distinct from *M. saxatilis* by the fishermen.

39. Liostomus xanthurus Lacépède. Spot; Porgy.
Leiostomus obliquus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 329.

No very young specimens were seen. Half-grown and adult examples are everywhere common.

The species is sometimes called "porgy" at Somers Point, but the usual name is "spot."

40. Bairdiella chrysura (Lacépède). (Pl. I, fig. 9.)
Corvina argyroleuca BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 331.

None but young individuals were seen, the largest specimen measuring about 2½ inches. The smallest is little more than 1 inch long. The species seems to be unknown to the fishermen. Beesley's Point is the favorite collecting ground for the silver perch. Numerous examples were seined there August 10 and 11.

An individual, 3½ inches long, was seined in a muddy hole in one of the thoroughfares near Somers Point, August 27.

The largest example taken was seined in a thoroughfare near Somers Point, August 30; it is 7 inches long.

Another example of equal size was caught in the seine at Beesley's Point, September 9, and half-grown ones of about 4 inches were moderately numerous.

41. Pogonias chromis (Linn.).
Pogonias fasciatus BAIRD, Rep. Fish. N. J., 1855, 18; Ninth Ann. Rep., Smith. Inst., 1855, 332.

Professor Baird made the following remarks about the drum:

"The young fish of this species were found very abundantly during August in the small bays along the shore about Beesley's Point. Few were seen in the rivers." Some of these are still preserved in the National Museum.

We did not find the species in the bay, but I saw scales of a large individual on one of the menhaden steamers.

42. **Stenotomus chrysops** (Linnæus). Sea porgy.

Pagrus argyrops BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 333.

Young individuals were taken sparingly at Ocean City, August 1. Small ones are frequently caught in seines along shore and on hooks in the bay.

This is called "sea porgy" to distinguish it from the "spot," which is sometimes styled "porgy."

43. **Archosargus probatocephalus** (Walbaum). Sheepshead. (Pl III, fig. 10.)

At Somers Point, August 8, two specimens were taken on hand-lines with fiddler-crab bait. The larger weighed 8 pounds and the smaller 5. The sheepshead is not common. Fishermen say that small specimens are not seen. The fishing places are about wrecks, wharf piles, and under steep banks in the thoroughfares.

Sixteen specimens, from 1 inch to about 1¼ inches, were seined at Beesley's Point, August 10 and 11.

Seven black bars on sides, and an other faint, narrow one, atcaudal base; interspaces yellowish green.

August 15, two additional specimens were caught on hand-lines.

An example 2.1 inches long and four smaller were taken at Beesley's Point, August 23. Several more were seined September 2 at the same place.

Seven more were caught at Beesley's Point, September 9, the largest of these is 2.1 inches long.

The young are found only at Beesley's Point, and in only one limited shore stretch there. It is well supplied with algæ, and there are convenient hiding places under the sod banks.

44. **Lagodon rhomboides** (Linnæus).

Young individuals, ranging from 3¼ to 4 inches in length, were taken at Beesley's Point, August 11. The species is not uncommon.

This fish is unknown to the fishermen.

Specimens were taken at Beesley's Point, September 9. The largest are about 5 inches long.

45. **Orthopristis chrysopterus** (Linnæus). (Pl. III., fig. 11).

At Beesley's Point, N. J., August 10, 1887, many young individuals were taken in the seine. D. XII, 16; A. III, 13; scales, 75.

A dark stripe beginning on nape and dividing sends one branch along the back on each side not far from dorsal outline. A dark stripe from eye to root of caudal. Cheeks and opercles with several narrow orange stripes. A narrow orange stripe between the two dark body stripes and another below the lower dark stripe. Below the second orange stripe the sides are marked with numerous orange spots, not continuous. These specimens are from less than 1 inch to more than 2 inches long.

Young examples were seined at Somers Point, August 13, and abundantly at Ocean City, August 16. The croaking sound made by these little fishes is quite noticeable.

September 5, Mr. W. S. Keates brought in two examples which had been caught on a hook with clam bait; these are 5¼ inches long, and much larger than the average size. Specimens from 4½ to 5 inches long were caught at Beesley's Point, August 23; in these there is only a trace of the black lateral stripe along the median line, and the sides have several broad, dark bands.

September 9 an individual 5¼ inches long was taken at Beesley's Point. This species is unknown to the fishermen. One angler described its croaking as resembling the quacking of a duck.

46. **Lutjanus griseus** (Linn.).

Lobotes emarginatus Baird, Rep. Fish. N. J., 1855, 18; Ninth Ann. Rep. Smith. Inst., 1855, 332.

Professor Baird found a few specimens in August among the grass along the river. His largest examples were 3 inches long.

We did not observe the species during our stay.

47. **Acantharchus pomotis** (Baird).

Centrarchus pomotis Baird, Ninth Ann. Rep. Smith. Inst., 1855, 325.

A single small individual was seined in Gravelly Run, a tributary of Great Egg Harbor River, September 6. Its associates were *Aphredoderus sayanus*, *Melanura pygmæa*, *Fundulus diaphanus*, and young *Esox reticulatus*.

48 **Enneacanthus obesus** (Girard).

Pomotis obesus Baird, Rep. Fish. N. J., 1855, 10; Ninth Ann. Rep. Smith. Inst., 1855, 324.

Professor Baird obtained this species only in the Cedar Swamp creeks, Cape May County and Atlantic County, among the splatter docks or in small runs or ditches.

49. **Mesogonistius chætodon** (Baird).

Pomotis chætodon Baird, Rep. Fish. N. J., 1855, 10; Ninth Ann. Rep. Smith. Inst., 1855, 324.

Professor Baird found the banded sunfish "abundant in the muddy water of Cedar Swamp Creek, Cape May County."

50. **Centropristis furvus** (Walbaum.) Blackfish. (Pl. III., fig. 12.)

Centropristes nigricans Baird, Ninth Ann. Rep. Smith. Inst., 1855, 323.

Both the young and half-grown fish are excessively abundant throughout the bay. Examples scarcely more than 1 inch long are very common. Larger individuals are caught in the deep channels than in shoal water.

An example 1⅛ inches long was the smallest one seen at Beesley's Point, September 9.

51. **Boleosoma olmstedi** (Storer).

Seven examples were taken in Gravelly Run, September 6. For a list of its associates see *Notemigonus chrysoleucus.* D. IX, 15; A. I, 10; scales, 48.

This species was not observed by Professor Baird in 1854.

52. **Boleichthys fusiforme** (Girard).

Boleosoma fusiformis BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 328.

Four examples were seined in Gravelly Run, September 6, associated with *Boleosoma olmstedi.*

D. X, 12; A. II, 7; scales, 49; lateral line on 18.

53. **Roccus americanus** (Gmelin). Perch.

Labrax mucronatus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 322.

Seined in large numbers at Beesley's Point, August 10 and 11, at the mouth of the river. Our examples are about 6 to 7 inches long. No young ones were taken.

In several of the salt water creeks emptying into the bay we seined great numbers of white perch on the last of the ebb tide. In salt water the species is called "yellow perch" by some of the fishermen; sometimes "perch" alone is used, and the pronunciation is changed as if the spelling were "peerch."

The principal fishery for white perch is by means of gill-nets in winter.

54. **Roccus lineatus** (Bloch). Rockfish.

Labrax lineatus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 321.

Small individuals, 8 inches long, were seined in the mouth of the river at Beesley's Point, August 10. Examples weighing 2 or 3 pounds are being caught with the hook at Tuckahoe River mouth, about the middle of September.

This is the "rock" or "rockfish" of Somers Point.

55. **Elacate canada** (Linnæus.) (Pl. II, fig. 13.)

A young example, 3¾ inches long, was caught at Somers Point, near the club house, August 2, 1887, by Capt. Richard Chamberlain. Ground color nearly black; a white stripe, about as wide as pupil, from upper angle of gill-opening to caudal; another one, but narrower, begins at lower extremity of pectoral base, curves very slightly upward, fading out near the tail; upper caudal lobe, with a narrow whitish margin along its upper surface, relieved by a trace of orange red at its base; lower caudal lobe with a narrow orange-red margin; pectorals, ventrals, and caudal black; back fades to a dark green; belly, grayish white; iris, golden bronze.

This species has not previously been recorded from Great Egg Harbor Bay, and the young seems not to have been described.

Another example, 4 inches long, was seined in one of the thoroughfares in the bay, August 23. This has the same markings as the first.

The caudal, when fully expanded, is rounded, the end truncate; there is no emargination as in the adult.

56. Pomatomus saltatrix (Linnæus). Snap-mackerel.
Temnodon saltator BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 337.

Numerous young individuals, ranging from 1¼ to 6 inches long, are found at Ocean City, Beesley's Point, and elsewhere. Several examples about 1 foot long were caught on hooks August 13, and on the same day we seined several specimens about 8 inches in length. Large fish are not taken here at present.

Schools of the young fish were seen in the bay August 15 and 16.

At Ocean City, August 31, young examples from 1¼ to 1½ inches long were seined.

At Ocean City the species is sometimes called "mackerel," but the usual appellation is "snap-mackerel" or "snapping-mackerel."

57. Aphredoderus sayanus (Gilliams).
Aphredoderus sayanus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 326.

Several examples were seined in Gravelly Run, a tributary of Great Egg Harbor River, September 6. For its associates see *Acantharchus pomotis*.

58. Sphyræna borealis De Kay.
Sphyræna borealis BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 326.

The young of this species, measuring 3 or 4 inches, was found abundant at Ocean City, August 1; also at Beesley's Point, August 10, where the smallest one observed is 2⅜ inches long.

The barracuda is unknown to the fishermen.

59. Sphyræna picuda Bl. Schn. (Pl. II, fig. 14.)

A single young example, 2 inches long, was taken at Beesley's Point, August 23. Scales in about 81 rows.

As far as I know this is the first record of the appearance of the young on our coast.

60. Mugil curema Cuv. and Val. Mullet.
Mugil albula BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 339.

Small mullet were seined at Ocean City, August 1, at Beesley's Point, August 10 and 11, and at Somers Point, August 13. At the latter place an individual was seined in a salt pond in company with *Cyprinodon*, *Lucania*, *Fundulus*, and *Menidia*. The largest example measures 4⅞ inches.

At Longport, August 29, some larger specimens were taken in the surf. The largest of these is 6¼ inches long. At Beesley's Point, September 2, specimens of equal size were caught.

61. Mugil albula Linnæus. Mullet.

Seven individuals, averaging about 7½ inches in length, were seined at Ocean City, August 16. In this seine haul there was the greatest lot of young fishes that we have secured thus far—the young *Bairdiella* was excessively abundant. *Fundulus majalis* and *heteroclitus*, *Menidia notata*, *Tetrodon turgidus*, and *Mugil curema* were also plentiful. It is said that *Mugil albula* of large size is not taken here.

The species of *Mugil* are called "mullet" at Somers Point.

62. Menidia notata Mitchill.

Atherinopsis notatus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 338.

Excessively abundant everywhere, the young schooling at the surface along shore and out in the bay. Small individuals were found in salt ponds, August 13, at Somers Point.

63. Menidia laciniata Swain.

Sand bar in Great Egg Harbor Bay, August 23, six specimens, ranging from 2¼ to 3¼ inches in length.

Not previously recorded from the region.

The species was found again in abundance at Somers Point, August 25.

At Longport, August 26 and 29, the species was again met, and here an individual 4⅓ inches long was taken, the largest one seen.

64. Apeltes quadracus (Mitchill).

Gasterosteus quadracus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 328.

Abundant at Beesley's Point, August 10 and 11. This species prefers the vicinity of fresh-water streams, where grass is plentiful.

65. Fistularia tabaccaria Linnæus.

Three individuals were seined at Ocean City, August 4, and one at Beesley's Point, August 11. This species can hardly be considered rare. It is frequently taken on Long Island and occasionally at Wood's Holl.

Another example was taken at Ocean City, August 16.

Six specimens were seined in thoroughfares near Somers Point, August 23, and eight more August 30.

A single individual was seined in a thoroughfare near Ocean City, August 31.

Three examples were seined at Somers Point, September 5, and two at Beesley's Point, September 9.

66. Tylosurus marinus (Bl. Schn.). Gar.

Belone truncata BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 346.

Young examples are common everywhere. A half-grown individual, about 18 inches long, was seined, August 10, at Beesley's Point.

The species is called "gar" at Somers Point.

67. Tylosurus gladius Bean. Gar. (Pl. II, fig. 15.)

A young example was seined at Ocean City, August 1. D. I, 21; A. I, 20. Length, 6½ inches.

A dark cutaneous flap attached along the side of the mandible and folded underneath, meeting its fellow of the opposite side and concealing a small portion of the lower jaw. Dorsal black, except on the first six rays, which are pale; much elevated at the posterior part, where the longest ray equals the distance from the middle of the eye to the end of the head.

Fourteen black blotches on sides not extending to caudal, the largest two-thirds as wide as length of eye. Paired fins, and anal pale. Caudal the same, except anterior half of upper lobe, on which the membrane covering the rays is black, while the intervals between the rays are pale. Back greenish; under surface, except mandibular flap, silvery.

This species has not previously been recorded in the region.

68. **Hemirhamphus roberti** Cuv. and Val. (Pl. III, fig. 16.)

A single young individual, 2¼ inches long, was seined at Longport, August 26. This species was not obtained by Professor Baird in 1854.

A fine example, 6¼ inches long, was taken in the seine at Becsley's Point, September 9. The crimson tip and membrane on lower jaw are very marked.

69. **Esox reticulatus** Le Suer. Pike. (Pl. I, fig. 17.)
Esox reticulatus Baird, Ninth Ann. Rep. Smith. Inst., 1855, 346.

Half-grown and young examples were seined in Gravelly Run, September 6. The markings of these specimens resemble those of *E. lucius*, the reticulations being inconspicuous. For a list of its associates see under *Notemigonus chrysoleucus*.

This is the "pike" of Somers Point.

70. **Esox americanus** Gmelin.
Esox fasciatus Baird, Rep. Fish. N. J., 1855, 31; Ninth Ann. Rep. Smith. Inst., 1855, 345.

Professor Baird records this species from Cedar Swamp Creek, where it was abundant. He describes a specimen 10 inches long, but individuals of considerably larger size were taken.

71. **Melanura pygmæa** (De Kay).
Melanura pygmæa Baird, Ninth Ann. Rep. Smith. Inst., 1855, 342.

A single small individual was caught in Gravelly Run, Atlantic County, September 6. Its associates were *Acantharchus pomotis*, *Aphredoderus sayanus*, young *Erimyzon oblongus*, young *Esox reticulatus*, and *Fundulus diaphanus*.

72. **Fundulus majalis** (Walbaum).
Hydrargyra flavula Baird, Ninth Ann. Rep. Smith. Inst., 1855, 344.

Abundant everywhere along the shores and found in salt ponds associated with *Cyprinodon*, *Lucania*, and other genera.

73. **Fundulus luciæ** (Baird).
Hydrargyra luciæ Baird, Rep. Fish. N. J., 1855, 30; Ninth Ann. Rep. Smith. Inst., 1855, 344.

Professor Baird took a few specimens only in a small ditch at Robinson's Landing, Peck's Beach, opposite Beesley's Point. This place is now called Miller's Landing, and the drainage system has been greatly changed. Diligent search was made for the species, but without result.

Professor Baird's specimens were about 1 inch long. The dorsal of his examples had a large black spot posteriorly and immediately anterior to it a white one.

74. **Fundulus heteroclitus** (Linnæus).

Fundulus zebra BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 342.

Found everywhere with the preceding.

75. **Fundulus diaphanus** Le Sueur.

Fundulus diaphanus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 343.
Fundulus multifasciatus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 344.

Seined in Gravelly Run, September 6. Common.

76. **Cyprinodon variegatus** Lacépède.

Cyprinodon ovinus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 345.

Numerous examples were seined in salt ponds near Somers Point, August 13. Among them were some very large males. The species was associated with *Lucania*, *Fundulus*, *Menidia*, and *Mugil.*

A few examples were seined, September 16, in ditches near Ocean City. For its associates see under *Gobiosoma.*

77. **Lucania parva** (Baird and Girard). (Plate II, fig. 18.)

Cyprinodon parvus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 345.

Found abundantly in salt ponds near Somers Point, August 13.

Seined in small numbers in ditches near Ocean City, September 16. See *Gobiosoma* for a list of its associates.

78. **Synodus fœtens** (Linnæus).

Saurus mexicanus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 346.

Adults and young of this species are rather common in this region. Professor Baird found a single specimen only in 1854. The species is common also in Great South Bay, Long Island.

At Beesley's Point, September 2, 1887, a small individual was found to have swallowed a *Pleuronectes americanus*, which distended the stomach of its captor laterally to nearly twice its normal width.

Abundant in thoroughfares near Somers Point August 30. One individual taken is 7¾ inches long. Some very large ones have been seen; an example caught at Beesley's Point, September 9, is nearly 9 inches long, and we have secured some larger than this.

The species is unknown to the fishermen.

79. **Etrumeus teres** (De Kay).

Alosa teres BAIRD, Rep. Fish. N. J., 1855, 35; Ninth Ann. Rep. Smith. Inst., 1855, 349.

Professor Baird's remarks are as follows:

> A number of specimens of this rare species were found one day in the edge of the surf along the beach; they seemed to be very weak, and died soon after their capture.

A single specimen, 5¾ inches long, was seined by Capt. Thomas Steelman after my departure from Somers Point.

80. **Clupea æstivalis** Mitchill. Herring.

Several examples, about 3¾ inches long, were seined near Somers Point August 13. This species was not observed by Professor Baird in 1854.

The young, ranging from 2 to 3 inches in length, were taken in abundance in Gravelly Run, September 6.

81. **Clupea mediocris** Mitchill. Herring.
Alosa mattowaca BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 349.

Heads of some individuals were picked up on the river beach near Beesley's Point, August 11.

August 23, near Beesley's Point, I found a perfect example, 11 inches long, lying on the shore, where it had been left by a seining party.

This species is known as "herring" at Somers point.

82. **Brevoortia tyrannus** (Latrobe). Bunker; Mossbunker; Menhaden.
Alosa menhaden BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 347.

August 8 and 9 numerous small schools and some large ones came into the bay. On the 8th sharks were among them. It is said that the menhaden do not often enter the bay.

August 13, again I saw many schools in the bay even well up as far as Beesley's Point. Sharks are reported plentiful among them.

August 23, near Beesley's Point, I saw several very large spoiled individuals lying on the shore, where they had been left by seiners.

September 10, in a thoroughfare near the draw-bridge (Beesley's Point), three large examples, 11 to 13 inches long, were taken in the seine; all of these were affected by lernæan parasites. Several young, under 4 inches long, were taken also.

83. **Opisthonema oglinum** (Le Sueur).
Chatœssus signifer BAIRD, Rep. Fish. N. J., 1855, 35; Ninth Ann. Rep. Smith. Inst., 1855, 349.

Professor Baird's remarks are as follows:

> A few specimens were taken in a net in the bay. In life the back is bright green; the caudal fin yellow, black at the tip.

84. **Stolephorus mitchilli** Cuv. and Val.

This anchovy was found in great abundance at Ocean City, August 1, and in small numbers at Beesley's Point, August 10 and 11. It is much more common near the ocean inlet, but is taken wherever the seine is hauled. No large examples have been seen thus far (August 18).

At Longport, August 27, specimens 3½ inches long were seined in the surf.

At Somers Point, August 25, adults were present in moderate numbers.

85. **Stolephorus browni** (Gmelin).
Engraulis vittata BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 347.

Very large specimens, averaging about 5 inches in length, were seined at Longport August 26 and 27. On the latter date we took them by hundreds in the surf at the beginning of the flood. Weakfish were also found there in abundance, feeding on these anchovies. We took 54 weakfish in two hauls of a 20-fathom seine.

The species was found sparingly also in a thoroughfare near Somers Point, August 30.

A few were seined again at Longport, September 8; the largest of these is nearly 5½ inches long.

A few were taken at Beesley's Point, September 9, and on the following day the species was noted in a thoroughfare near the draw-bridge.

86. **Stolephorus eurystole** Swain & Meek. (Pl. III, fig. 19.)

Young individuals were seined at Ocean City, August 1. No adults have been seen.

Numerous young examples were taken at Longport, August 29, in the surf, associated with *S. mitchilli*.

87. **Erimyzon oblongus** (Mitchill). Chub sucker. (Pl. I, fig. 20.)

Catostomus gibbosus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 341.

The chub sucker was seined in large numbers of young and adults in Gravelly Run, September 6. For its associates see under *Notemigonus chrysoleucus*.

88. **Catostomus teres** (Mitchill). Sucker.

Two examples were seined in Gravelly Run, September 6. The species is called "sucker."

89. **Notemigonus chrysoleucus** (Mitchill). Roach.

Leucosomus americanus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 341.

The roach was found abundant in Gravelly Run, September 6. It was associated with *Erimyzon oblongus*, *Catostomus teres*, *Boleosoma olmstedi*, *Boleichthys fusiforme*, *Esox reticulatus*, *Fundulus diaphanus*, *Roccus americanus*, *Roccus lineatus*, young *Clupea æstivalis*, and *Anguilla rostrata*.

90. **Amiurus natalis** (Le Sueur). Catfish.

Five specimens were obtained in Bargaintown Pond, August 19, by Mr. L. T. Imlay. The anal rays in all those examined were 27.

The species is known as "catfish."

91. **Ælurichthys marinus** (Mitchill).

Ailurichthys marinus BAIRD, Rep. Fish. N. J., 1855, 27, Ninth Ann. Rep. Smith. Inst., 1855, 341.

Professor Baird's record of this species is as follows:

> The sea-cat or channel-cat was occasionally taken with the hook in the channel of the river. Nothing specially was learned of its habits. The flesh is very indifferent, being coarse and rank, tasting much like that of small sharks.

No specimens were taken during our stay at Somers Point.

92. **Conger conger** (Linn.). Sea eel.

Conger occidentalis BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 351.

Two skinned and headless examples were brought in to Somers Point by a fishing party September 4. One of these measured 21 inches. They are said to be common at Anchoring Point.

A perfect specimen was caught by Mr. Charles Clements, September 7, and presented to the collection.

Another fine individual was given to me by the same gentleman, September 9; it was caught at the wreck.

On the 18th of September another one was taken on a hook by Bolton E. Steelman.

This eel, known here as "sea eel," is taken not infrequently by anglers.

93. **Anguilla rostrata** (Le Sueur). Eel.

Anguilla tenuirostris BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 350.

A small example was seined at Ocean City, August 4, and a great many small and large were taken at Beesley's Point, near the river mouth, August 10 and 11.

The species was sufficiently common in salt water in most parts of the bay, and particularly about the salt marshes.

94. **Raia eglanteria** Lacépède. Skate.

A single example was obtained, August 28, at Somers Point. Several were caught with hooks, August 27, by fishing parties and thrown away.

95. **Raia lævis** Mitchill.

A decayed example, apparently of this species, was picked up at Beesley's Point, September 9, where it had been left by seiners. The teeth are in about 30 rows. There is a median row of strong spines on the tail, but no lateral rows on the portion remaining (part of the tail was cut off). The color is dark, and the snout does not seem to have been long enough for *lævis*, but the dentition fits nothing else.

96. **Trygon hastata** De Kay. Stingaree.

Pastinaca hastata BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 353.

Two small individuals were caught in a large seine at Ocean City, August 1. Anglers have caught several of them in the bay. An example weighing 30 or 40 pounds was reported by Captain Chamberlain August 13.

97. **Myliobatis freminvillei** (Le Sueur). Stingaree.

A single example of moderate size was caught in the inlet near Longport, August 29, by Mrs. Huston, who presented it to the National Museum collection.

Some of the crew of the menhaden steamer *Annie Morris* told me that about August 20, off Hereford Inlet, they saw schools of stingrays at the surface "flopping along like geese." The schools were large enough to fill a menhaden seine.

As the species was said to have two spines, I have placed the statement under *Myliobatis*.

98. **Sphyrna zygæna** (Linnæus). Shovel-nose shark.

An individual, 25 inches long, was caught on a hook in the bay August 13, and another, 22 inches long, was given to me, August 16, by Silas

Boise. Still another small one was caught August 15. The species is often taken while fishing for weakfish. No large examples have been seen by me, but Captain Chamberlain reports one of 5 or 6 feet. This is the "shovel-nose shark" of the fishermen, although not the "shovel-nose" of the books.

The hammer head shark was not found by Professor Baird in 1854, but the true "shovel-nose" was common.

99. **Reniceps tiburo** (Linn.).

Zygæna tiburo BAIRD, Rep. Fish. N. J., 1855, 39; Ninth Ann. Rep. Smith. Inst., 1855, 353.

Professor Baird obtained one specimen of this shark and the fishermen took several more. Singularly enough we failed to see this species, but the "hammer-heap shark," which was not seen by Professor Baird, was taken frequently by us.

100. **Carcharias obscurus** (Le Sueur). **Man-eating shark.**

Carcharias cæruleus BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 352.

Abundant in the bay. Young individuals, caught with hooks, July 29, and measuring 21½ to 24 inches in length, still bear the umbilical scar. Examples 7 feet long have been seen. Recently, while the bay was visited by large schools of menhaden, sharks were unusually abundant.

This is the "man-eating shark" of Somers Point. A specimen weighing 150 pounds was reported July 23, and during the same week Charles Steelman landed one weighing 200 pounds.

101. **Mustelus canis** (Mitchill). **Dog shark.**

Mustelus canis BAIRD, Ninth Ann. Rep. Smith. Inst., 1855, 353.

Very common and very annoying to anglers. A small individual was seined at Ocean City, August 1. No adults have been observed.

This is known as "dog shark" at Somers Point.

U. S. NATIONAL MUSEUM,
Washington, December 8, 1887.

EXPLANATION OF PLATES.

PLATE I.

Fig. 1. **Astroscopus anoplus,*** p. 136.
2. **Astroscopus anoplus, head,*** p. 136.
4. **Chætodon maculocinctus, 2½ times natural size,** p. 138.
9. **Bairdiella chrysura,†** p. 141.
17. **Esox reticulatus,*** p. 147.
20. **Erimyzon oblongus,*** p. 150.

PLATE II.

6. **Cynoscion regale,*** p. 140.
7. **Menticirrus saxatilis, ½ natural size,** p. 141.
13. **Elacate canada, ½ natural size,** p. 144.
Fig. 14. **Sphyræna picuda,†** p. 145.
15. **Tylosurus gladius, ⅓ natural size,** p. 146.
18. **Lucania parva,†** p. 148.

PLATE III.

3. **Tautoga onitis,†** p. 137.
5. **Trachynotus rhomboides,†** p. 139.
8. **Menticirrus saxatilis,† differing from fig. 7 in color, height of first dorsal, and length of snout,** p. 141.
10. **Archosargus probatocephalus,†** p. 142.
11. **Orthopristis chrysopterus,†** p. 142.
12. **Centropristis furvus,*** p. 143.
16. **Hemirhamphus roberti,*** p. 147.
20. **Stolephorus eurystole,†** p. 150.

---

* Natural size.

† Twice natural size.

PLATE I.

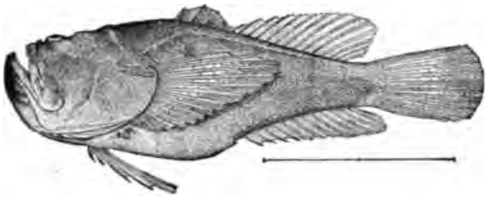


Fig. 1.

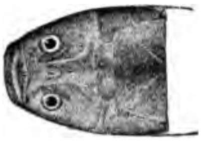


Fig. 2.

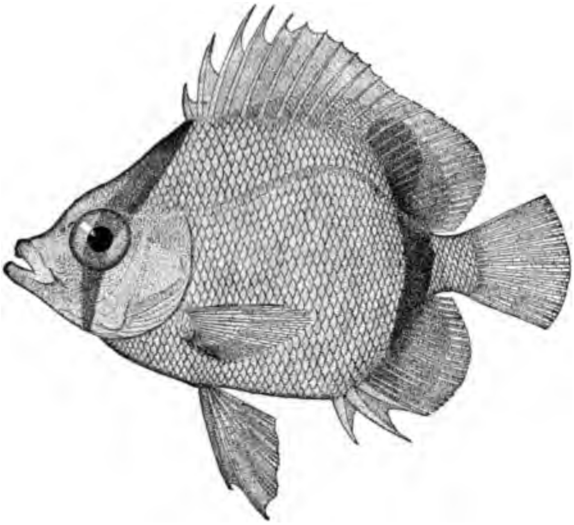


Fig. 4.

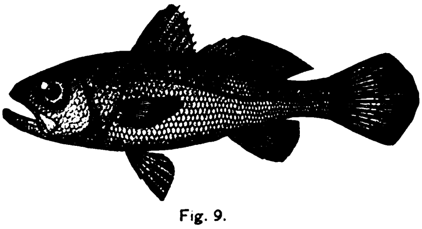


Fig. 9.

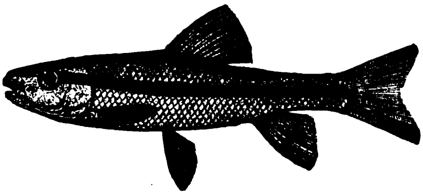


Fig. 20.

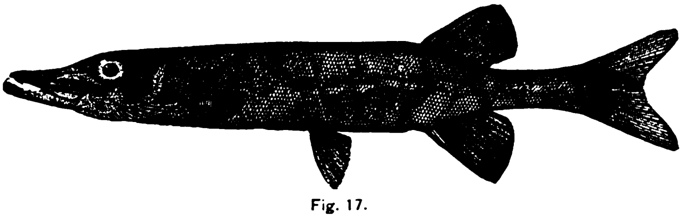


Fig. 17.

Page.
Leiostomus obliquus 141
Leucosomus americanus 150
Lichia carolina 140
spinosa 139
Liostomus xanthurus 132, 141
Lobotes emarginatus 129, 143
Lucania parva 132, 148
Lutjanus griseus 130, 132, 143
Mackerel 138, 145
Man-eating shark 152
Melanura pygmæa 132, 143, 147
Menhaden 149
Menidia laciniata 130, 132, 146
notata 132, 146
Menticirrus alburnus 132, 141
saxatilis 132, 141
Mesogonistius chætodon 130, 132, 143
Monacanthus hispidus 131, 133
Mossbunker 149
Mugil albula 132, 146
curema 132, 146
Mullet 145
Mustelus canis 132, 152
Myliobatis freminvillei 132, 151
Notemigonus chrysoleucus 132, 144, 147, 150
Ophidium marginatum 130, 131, 135
Opisthonema oglinum 130, 132, 149
Orthopristis chrysopterus 130, 132, 142
Otolithus regalis 140
Oyster-fish 135
Pagrus argyrops 142
Paralichthys dentatus 131, 135
Pastinaca hastata 151
Peprilus triacanthus 140
Perch 144
Pike 147
Platessa ocellaris 135
plana 135
Pleuronectes americanus 131, 135, 148
Pogonias chromis 130, 132, 141
fasciatus 141
Pomatomus saltatrix 132, 145
Pomotis chætodon 129, 143
obesus 143
Porgy 141
Poronotus triacanthus 131, 140
Prionotus palmipes 131, 136
pilatus 136
strigatus 131, 136
Raia eglanteria 132, 151
lævis 132, 151
Reniceps tiburo 130, 132, 152

Page.
Rhombus maculatus 135
Roach 150
Roccus americanus 132, 144, 150
lineatus 132, 144, 150
Rock 144
Rockfish 144
Sarda sarda 131, 138
Saurus mexicanus 148
Scomber pneumatophorus 131, 138
scombrus 131
Scomberomorus maculatus 131, 138
Sea eel 150
porgy 142
Selene gallus 131, 139
Seriola zonata 131, 139
Shark's pilot 139
Sheepshead 142
Shovel-nose shark 130, 151
Siphostoma fuscum 131, 134
Skate 151
Smooth blackfish 137
Snap-mackerel 145
Snapping-mackerel 145
Sparisoma 131, 137
Sphyræna borealis 132, 145
picuda 130, 132, 145
Sphyrna zygæna 130, 132, 151
Spot 141
Stenotomus chrysops 132, 142
Stolephorus browni 132, 149
eurystole 132, 150
mitchilli 132, 149, 150
Sucker 150
Summer flounder 135
Sunfish 134
Synodus fœtens 132, 148
Tautoga onitis 131, 137
americana 137
Temnodon saltator 144
Tetraodon turgidus 133
Tetrodon turgidus 131, 133, 146
Thimble-eye mackerel 131
Toadfish 133
Trachynotus carolinus 131, 140
rhomboides 131, 139
Trygon hastata 132, 151
Tylosurus gladius 130, 132, 146
marinus 132, 146
Umbrina alburnus 140
Weakfish 140
Window-light 135
Winter flounder 135

43.—REPORT OF THE MOVEMENTS AND OPERATIONS OF THE FISH COMMISSION STEAMER ALBATROSS FROM SEPTEMBER 15 TO 20, 1887.

By Lieut.-Commander Z. L. TANNER, U. S. Navy, Commanding.

At 7 a. m., the 15th instant, we cast off from the wharf at the Columbian Iron Works and Dry Dock Company and proceeded down the river, having on board one naturalist, Mr. Thomas Lee. We were detained off Thomas's Point about four hours by grounding—no damage done. We passed the capes of the Chesapeake at 5 a. m. the following morning and stood to the eastward. The weather was clear with a strong east-northeasterly breeze which caused a moderate head sea. At 2.40 p. m. (latitude 36° 52′ north, longitude 74° 23′ west) we cast the trawl in 958 fathoms br. Oz. It came up at 6.10 with no indications of having been on the bottom; a number of interesting specimens were obtained from intermediate depths. Several steamers were sighted during the day standing to the southward.

At 5.10 a. m. on the 17th (latitude 37° 35′ north, longitude 74° 11′ west) we sounded in 352 fathoms, wh. S. and P., Hyd. No. 1090, and at 7.30 cast the lead in 811 fathoms, gy. M. (latitude 37° 34′ north, longitude 73° 58′ west) and put the trawl over, the result being a number of fish, crustaceans, cup-corals, and mollusks. We sounded again at 11.26 in 1,011 fathoms, br. Oz. (latitude 37° 40′ north, longitude 73° 50′ west) and put the trawl over, but in heaving in the dredge-rope parted losing the trawl and its appurtenances and about 6 fathoms of rope. Another haul was made at 3.49 in 852 fathoms, bu. M. (latitude 37° 44′ north, longitude 73° 57′ west), securing one octopus, a number of cup-corals, penatulas, shrimp, shells, lithodes, hake, red hake, and a number of coryphænoids. At 6.25 we made the last haul for the day in 865 fathoms, gn. M. (latitude 37° 46′ 30″ north, longitude 73° 56′ 30″ west), bringing up a few crustaceans and a large number of cup corals. The large surface net was used successfully during the day.

On the 18th, at 5 a. m., we made a hydrographic sounding in 255 fathoms wh. S. and P. (latitude 38° 31′ north, longitude 73° 15′ west). At 8.06 cast the trawl in 1,155 fathoms, gy. Oz. (latitude 38° 31′ north, longitude 72° 53′ west). It came up at 10.56—a water haul. Three more hauls were made during the day in from 554 to 102 fathoms, gn. M., between latitude 38° 31′ and 38° 42′ north, and longitude 73° 05′ 15″ and 73° 05′ 45″ west, obtaining 12 pole flounders, 10 specimens of Macrurus, a few crustaceans, shells, a few hake, whiting, shrimp, sponges, 1 skate's egg, sea-anemones, star-fish, and 1 octopus. The surface net was towed whenever practicable. The weather continued pleasant with light easterly winds. During the day a whale and a school of porpoises were seen near the ship.

At 5.22 on the morning of the 19th we cast the trawl in 1,276 fathoms, bu. M. (latitude 39° 27′ north, longitude 71° 16′ west). It came up with a few specimens of fish, 1 squid, 2 octopi, a number of sea-urchins, brittle stars, 10 specimens Holothurians (Benthodytes) and a number of shells. Two more hauls were made during the day in from 1,163 to 705 fathoms, gn. M. and Oz., between latitude 39° 31′ and 39° 42′ north, and longitude 71° 14′ 30″ and 71° 17′ west, securing a number of blue hake, Macrurus Bairdii, 3 specimens of Geryon, etc. The last haul brought up a large number of skates' eggs. The surface net secured several rare specimens of crustacea, squid, etc. During the day several sailing vessels were sighted.

At 6.15 p. m. we started for Wood's Holl, arriving and making fast to the Fish Commission wharf at 9.50 a. m., September 20. The cruise was considered as a trial trip for the new boilers as well as for the sounding and dredging apparatus, all of which worked satisfactorily. A few rivets and one or two stay bolts in the boilers were found leaky, and they will be made tight by the contractor.

The dredging and trawling record and the record of temperatures and specific gravities are appended. I wish to call attention to the latter, as it presents a series of specific gravities from Baltimore down the Patapsco river and Chesapeake Bay to the sea, showing the gradual increase of saline matter in the water till it finally reaches the density of the open sea.

U. S. FISH COMMISSION STEAMER ALBATROSS,
Wood's Holl, Mass., September 20, 1887.

Dredging and trawling stations.

Serial No.	Date.	Hour.	Position.		Depth.	Character of bottom.	Wind.		Drift.		Instrument used.
			Latitude North.	Longitude West.			Direction.	Force.	Direction.	Force.	
	*1887.		° ′ ″	° ′ ″	*Faths.*						
2736*	Apr. 8	11 a. m.	Fortress Monroe.		11	S.	E.	4	....	....	S. B. T.
2737*	Apr. 8	11.17 a. m	Fortress Monroe.		12	S.	E.	4	....	....	S. B. T.
2738	Sept. 16	3.14 p. m.	36 52 00	74 23 00	958	gn. Oz	NNE.	6	NW. by W.	1	L. B. T.
2739	Sept. 17	8.03 a. m.	37 34 30	73 58 00	811	gy. M.	NE.	4	NNW.	1	L. B. T.
2740	Sept. 17	11.32 a. m.	37 40 00	73 50 00	1,011	br. Oz.	NE. by N.	4	NW. by N.	1½	L. B. T.
2741	Sept. 17	3.49 p. m.	37 44 00	73 57 00	852	gn. M	NNE.	4	N.	1	L. B. T.
2742	Sept. 17	6 25 p. m.	37 46 30	73 56 30	865	bu. M.	NNE.	2	NW. by W.	1	L. B. T.
2743	Sept. 18	8 06 a. m.	38 31 00	72 53 00	1,155	gn. Oz.	ESE.	2.3	NW.	1	L. B. T.
2744	Sept. 18	11.48 a. m.	38 35 00	73 05 15	554	bu. M	E.	2	N. by E.	½	L. B. T.
2745	Sept. 18	4.20 p. m.	38 42 00	73 05 30	224	gn. M	SE.	2	NNE.	½	L. B. T.
2746	Sept. 18	5.14 p. m.	38 46 00	73 05 45	102	gn. S	SE.	2	W.	¾	L. B. T.
2747	Sept. 19	6.05 a. m	39 27 00	71 15 00	1,276	bu. M.	NNW.	2	S.	1	L. B. T.
2748	Sept. 19	10.53 a. m	39 31 00	71 14 30	1,163	gy. M. For	SW.	1	W.	1	L. B. T.
2749	Sept. 19	3.20 p. m.	39 42 00	71 17 00	703	gn. Oz.	S.	2.3	NW.	½	L. B. T.

* Hauls made for the purpose of instructing the officers of the U. S. S. *Thetis* in the use of the dredging apparatus.

Record of temperatures and specific gravities taken on board steamer Albatross.

Date.	Time of day.	Station or locality.	Depth.	Temperature by attached thermometer.	Temperature of the air.	Temperature of specimen at time specific gravity was taken.	Specific gravity.	Specific gravity reduced to 60° F.	Remarks.
1887.				°	°	°			
Sept. 5	1.30 p. m.	Wharf Columbian Iron Works, Baltimore, Md.	Low water surface.	75	76	74	1.0030	1.005086	Specimens retained in lower laboratory until they had acquired the temperature of the room.
5	3.30 p. m.	Wharf Columbian Iron Works, Baltimore, Md.	High water surface.	74	69	72	1.0034	1.005164	
15	7.15 a. m.	Fort McHenry, Baltimore	Surface	72	70	73	1.0038	1.005724	
15	7.45 a. m.	Fort Carroll, Baltimore	do	73	70	72	1.0040	1.005764	
15	9 a. m.	Chesapeake Bay	do	72	71	83	1.0048	1.008526	Off mouth Magothy River.
15	10 a. m.	do	do	72	72	83	1.0063	1.010026	Off Thomas's Point.
15	4 p. m.	do	do	73	75	80	1.0080	1.011160	Off Bloody Point Bar light.
15	5 p. m.	do	do	73	74	81	1.0084	1.011739	Off Plum Point.
15	6 p. m.	do	do	73	74	81	1.0088	1.012139	Off Taylor's Island.
15	7 p. m.	do	do	74	73	81	1.0094	1.012739	Between Cedar Point and Point No Point.
15	8 p. m.	do	do	74	73	81	1.0096	1.012939	Off Saint Jerome's Creek.
15	9 p. m.	do	do	75	72	81	1.0100	1.013339	Off mouth Potomac.
15	10 p. m.	do	do	75	72	81	1.0124	1.015739	Off Smith's Point.
16	7 a. m.	Off Cape Henry, Va	do	73	67	78	1.0214	1.024208	Cape Henry bearing W., distant 20 miles.
16	12 m.	Lat. 36° 54′ N., Long. 74° 46′ 30″ W	do	78	71	78	1.0228	1.025608	
17	12 m.	Lat. 37° 40′ N., Long. 73° 50′ 30″ W	do	70	65	82	1.0228	1.026320	
18	12 m.	Lat. 38° 35′ N., Long. 73° 05′ 00″ W	do	69	64	81	1.0230	1.026339	
19	12 m.	Lat. 39° 34′ N., Long. 71° 17′ 00″ W	do	69	71	81	1.0234	1.026730	

44.—STATISTICS OF THE FISHERIES OF THE PROVINCE OF BRITISH COLUMBIA FOR THE YEAR 1887.

BY THOMAS MOWAT,

Inspector of Fisheries for British Columbia.

Detailed statement of the number of persons, the quantity of apparatus, and the amount of capital employed in the fisheries of the Province of British Columbia during the year 1887, together with the quantities and values of the various products.

PERSONS EMPLOYED.

Sailors	229
Fishermen	3,095
Native hunters	295
Shoresmen	2,535
Total	6,154

APPARATUS AND CAPITAL EMPLOYED.

Apparatus specified.	Number.	Value.
(*a*) Vessels and boats:		
Steamers, schooners, and sloops	90	$137,500
Fishing boats	991	41,915
Cedar canoes	181	6,240
Flat-boats and scows	96	14,725
Total	1,358	200,380
(*b*) Gill-nets and seines:		
Salmon gill-nets	1,379	127,450
Salmon seines	19	7,700
Herring seines	41	7,700
Other seines	53	19,225
Total	1,492	162,075
(*c*) Shore property—estimated value:		
Canneries	20	360,000
Oil factories	2	15,000
Salting stations	....	20,000
Freezing establishments	2	10,000
Total	....	405,000

QUANTITIES AND VALUES OF PRODUCTS.

Kinds specified.		Quantities.	Prices.	Values.
(*a*) Fish:				
Salmon, fresh	pounds	2,226,600	$0.10	$222,660.00
Salmon, smoked	do	31,050	.16	4,968.00
Salmon, salted	barrels	4,459	12.00	53,508.00
Salmon, canned (in one-pound cans)	pounds	9,795,984	.12	1,175,518.08
Sturgeon, fresh	do	249,000	.06	14,940.00
Halibut, fresh	do	386,000	.10	38,600.00
Herring, fresh	do	206,000	.03	6,180.00
Herring, smoked	do	14,500	.10	1,450.00
Trout, fresh	do	55,500	.10	5,550.00
Eulachon, fresh	do	25,500	.06	1,530.00
Eulachon, salted	barrels	115	12.00	1,380.00
Eulachon, smoked	boxes	350	2.00	700.00
Assorted fish	pounds	712,000	.05	35,600.00
Shellfish, sardines, and anchovies (estimated)		....	....	18,500.00
Total		....	....	1,581,084.08
(*b*) Other products:				
Skins:				
Fur seal	number	33,800	7.00	236,600.00
Hair seal	do	3,500	.75	2,625.00
Sea otter	do	75	60.00	4,500.00
Oil:				
Eulachon	gallons	340	1.00	340.00
Dogfish (refined)	do	67,500	.50	33,750.00
Mixed (refined)	do	40,000	.40	16,000.00
Total		....	....	293,815.00

Detailed statement of the number of persons, the quantity of apparatus, and the amount of capital employed in the fisheries of the Province of British Columbia, etc.—Continued.

QUANTITIES AND VALUES OF PRODUCTS—Continued.

Kinds specified.	Quantities.	Prices.	Values.
(*c*) Estimate of products consumed locally:			
Fish consumed in the province			$100,000.00
Fish and oil consumed by Indians:			
Salmon			2,732,500.00
Halibut			190,000.00
Sturgeon and other fish			260,000.00
Fish oil			75,000.00
Total			3,357,500.00
Grand total, approximate yield			5,232,390.08

NEW WESTMINSTER, B. C., *March* 12, 1888.

45.—NOTES ON THE FISHERIES OF BUZZARD'S BAY AND VICINITY.

BY WILLARD NYE, JR.

The unusual amount of fresh water, caused by the heavy rains on the south coast of Massachusetts this spring, apparently attracted the alewives into the mouths of the rivers in great numbers. At the first dam on the Mattapoisett River 1,250 hauls were made, this being the best record for one season in twenty years. Traps along shore have also made large hauls.

The coldness of the water inshore, as well as the quantity of fresh water from the rivers, probably kept the scup away from the shore, as the traps, up to June 1, made light hauls. Scup appeared in such numbers, June 4, off Newport, R. I., and at the mouth of the Sakonnet River, as to bring down the price so that it hardly paid to ship them to New York. April 19, 395 pounds of tautog (averaging 3 pounds each in weight) were taken with a seine from a salt-water pond at the east end of Martha's Vineyard Island, where they probably had been all winter, as fishermen frequently caught them when spearing eels through the ice. At Menemsha Pond, at the west end of the island, tautog have been known to float ashore by the hundred during winters when anchor frost has occurred. More striped bass have been taken this spring than for several years. The best catch made by one trap was 70 in two mornings (about May 20), the weight of the fish ranging from 1½ pounds to 5 pounds. One salmon weighing 2 pounds was caught at Sconticut Neck.

Butterfish are very plentiful, a trap near Round Hill taking 15 barrels one night. Kingfish are more numerous than for several years; but none have been taken weighing over 3 pounds, the average weight being 1½ pounds. Thus far the indications are that there will be a considerable increase of migratory food-fish on our coast this season over the preceding three or four years.

NEW BEDFORD, MASS., *June* 6, 1888.

46.—THE AMERICAN SARDINE INDUSTRY IN 1886.

By R. EDWARD EARLL and HUGH M. SMITH.

SYNOPSIS.

I. Early History of the Industry.
II. Present Status of the Business.
III. The Weir Fisheries.
    The weirs.
    Profits of weir fishing.
    Movements of the herring.
    Fishing the weirs.
    The weir-boats.
    The regulation of the weir fisheries by the Canadian Government.
    Prevention of damage to weirs from moving ice.
    Use of large weir herring for smoking and bait.
    Fishing season for sardine herring.
    Interference of squid and mackerel with weir fishing.
IV. Torching and Seining for Herring.
    Torching.
    Seining.
V. Transfer of Herring from the Weirs to the Canneries.
    Unit of measure.
    The collecting-boats.
    Prices of fish and wages of fishermen.
    Methods of collecting the fish.
    Proportion of American and Canadian fish consumed.
VI. The Canneries and their Products.
    Description of canneries.
    Methods of preparation.
    Changes in manufacture.
    Cost of preparation.
    Wages paid.
    Shipments and markets.
    Dependence of Eastport and the surrounding country on the sardine industry.
VII. International and Economic Questions Involved.
    Effects of termination of treaty of Washington.
    Unfriendly action of Canadian Government.
    Present needs of the sardine industry.
    Probable effect of collecting import duty on Canadian fish.
VIII. Statistics of the Industry.
    Table of persons employed.
    Table of apparatus and capital.
    Table of products.

INTRODUCTORY NOTE.

In view of the important questions arising out of the fishery trade between the State of Maine and the Province of New Brunswick, that had been pending since the expiration of the Treaty of Washington and prior thereto, Prof. Spencer F. Baird, then United States Commissioner of Fish and Fisheries, deemed it advisable to have at hand available for reference full and accurate information on this subject. Accordingly, in the fall of 1886, Mr. R. Edward Earll was instructed to proceed to Maine and make as extensive an inquiry as the time would permit into the effects of recent legal procedures on the mutual fishery interests of the adjoining countries, especially the sardine, smoked herring, and frozen-herring trades, and the condition and needs of these industries. The investigation of the American sardine business was naturally the most important topic under consideration, and the accompanying report, which, in the absence of Mr. Earll, has been prepared under my direction from his field notes, is the result of that inquiry. Mr. Earll was ably assisted in the field-work by Mr. Merwin-Marie Snell, to whom much credit is due. Mr. Snell has also rendered me valuable aid in the elaboration of the notes. The sixth division of the report, on factories and products has been prepared by him, principally from notes furnished by Mr. Earll.

HUGH M. SMITH.

WASHINGTON, D. C., *July* 12, 1888.

I.—EARLY HISTORY OF THE INDUSTRY.

The first experiments in the manufacture of sardines occurred just twenty years ago, when Mr. George Burnham, an extensive packer of lobsters and other canned goods, conceived the idea of utilizing the small herring which occurred in such abundance in the vicinity of Eastport by packing them in oil as a substitute for the French sardines. In order to familiarize himself with the methods employed in the preparation of sardines he went to France and made a tour of inspection of the sardine canneries of that country, having with him a man who hired out as a laborer that he might thoroughly acquaint himself with the details. Returning to the United States he came to Eastport and began experiments in putting up the herring, but his studies in France had proved too superficial and he met with obstacles which he was not able to overcome. Again and again the little herring were packed in oil, but upon opening the cans they were invariably found to have a strong and unpleasant flavor which forcibly reminded one of rancid herring oil, and all attempts to keep them for any extended period proved ineffectual. Mr. Burnham soon became discouraged and abandoned the work. The failure, as he has since informed me, was principally due to his not having removed the moisture from the fish before canning them; and this moisture remaining in the cans mixed with the oil and soon became tainted, thus imparting an unpleasant flavor, not only to the fish but to the pure olive oil in which they were packed.

Nothing more was done in this business till near the close of the Franco-Prussian war. At this time a large trade had been developed in oil sardines from France, and in Russian sardines and anchovies. The war in France seriously interfered with the packing of these fish, and with their exportation to this country, and the trade was so thoroughly disorganized that the New York importers began looking about for some other fish to take their place. Hearing of the abundance of herring at Eastport they sent an order for a small quantity, thinking that possibly they could be utilized as Russian sardines. On their arrival in New York they were carefully examined, and the firm were of the opinion that with the proper methods of preparation they could be utilized for this purpose, and additional quantities were ordered and packed for shipment to he trade.

It was soon found more profitable to have the fish prepared in Eastport than in New York, and Mr. Henry Sellmann went to Eastport and gave his attention to the work. After examining the freshly-caught herring he felt satisfied that there was a future for the herring as a sardine fish, and informed Messrs. Wolff & Reesing, with whom he was at that time associated, to that effect. The firm entered enthusiastically into the work, encouraging Mr. Sellmann in his experiments, which were at first carried on in the kitchen of his boarding-house. Soon fish of medium quality, though far inferior to those now packed, were prepared, and in 1875 about two or three hundred cases were put up.

From that time the business increased with marked rapidity and others became interested in it. Prior to 1880, however, it was confined wholly to the village of Eastport. During this season a factory was built at Robbinston, a few miles to the northward of the Saint Croix River, and one or two others were started at Lubec, while others still were built at Jonesport, Millbridge, Lamoine, and Camden. During that year there were packed on the coast of Maine, in all, $800,000 worth of the various grades of sardines, including Russian sardines, anchovies, and sardines in oil, mustard, spices, and tomato sauce.

II.—PRESENT STATUS OF THE BUSINESS.

The following table contains a statement of the sardine canneries in operation in Maine in 1886, with their location and date of establishment. In 1880 there were but nineteen canneries running, which number had increased to forty-five in 1886. Of the factories operated in 1880, eleven were still used in 1886, although some were under different management.

Name of firm and location of factory.	Date of establishment.	Name of firm and location of factory.	Date of establishment.
A. H. Wentworth & Co., Robbinston	1881	Hiram C. Comstock & Co., North Lubec	1881
Frontier Packing Co., Robbinston	1880	Reynolds & Avery, North Lubec	1886
Saint Croix Packing Co, North Perry	1886	E. P. Lawrence & Co., North Lubec	1885
Quoddy Packing Co., Harris Cove, Eastport	1886	Lubec Packing Co., North Lubec	1880
Charles H. Brewster, Eastport	1882	Parker & Pike, Lubec	1883
Peter M. Kane, Buckman's Head, Eastport	1876	New England Sardine Co., Lubec	1881
William A. Balkam, Eastport	1883	A. W. Lamson & Co., Lubec	1884
American Sardine Co., Eastport	1879	E. W. Brown & Co., Lubec	1881
Hiram Blanchard & Sons, Eastport	1880	Green & Kelley, Cutler	1886
Daniel McCullough, Eastport	1881	Stimpson & Young, Jonesport	1881
E. A. Holmes, Eastport	1880	Jonesport Packing Co., Jonesport	1882
M. C. Holmes & Co., Eastport	1881	William Underwood & Co., Jonesport	1880
Stimpson & Young, Eastport	1880	H. F. Sawyer, Millbridge	1885
George O'Grady & Co., Eastport	1881	Millbridge Packing Co., Millbridge	1881
J. D. Young, Eastport	1881	Lamoine Packing Co., East Lamoine, Hancock	1880
Eagle Preserved Fish Co., three factories, Eastport	1875 1881 1882	Bass Harbor Packing Co., Bass Harbor, Tremont	1882
Capen & McLain, Eastport	1881	Brooklin Canning Co., Brooklin (or Center Harbor)	1883
John Henderson, Eastport	1886	S. B. Morey, West Deer Isle	1886
Hallett Brothers, Eastport	1884	Deer Isle Packing Co., Green's Landing	1886
R. C. Green & Co., Eastport	1860	Green's Landing Packing Co., Green's Landing	1886
Pembroke Packing Co., East Branch Pembroke River, Pembroke	1885	T. Warren & Co., Green's Landing	1886
The West Branch Sardine Co., West Branch Pembroke River, Pembroke	1886		

Several additional canneries have been started at other points and run with varying success for one or more seasons. Among these was one at Round Pond, located in the old menhaden factory of L. Bightman & Co., which was bought by Wolff & Reesing and fitted up for the canning of sardines and mackerel at an expense of $30,000. It had a capacity of 50,000 cases of mackerel per season, in addition to the sardines, and the steamer David H. Wilson was fitted out for purse-seining to supply the mackerel needed for the purpose. The weir fisheries of the regions in which this and the other unsuccessful factories were located were not sufficiently extensive to keep them supplied with herring, though most of those who have given any attention to the matter agree that small herring are very abundant along nearly all portions of the coast of Maine east of the Penobscot River and in certain localities farther west. They seem to prefer a bold and rocky shore, with numerous islands and ledges, about which they gather in large schools for the purpose of feeding. Twenty years ago quite a number of weirs were fished along certain portions of the coast of eastern Maine, the catch being pressed for oil and fertilizer, and quite a profitable business was carried on; but, with the decline in the price of oil, the weirs were abandoned, and during the years that have elapsed the fishermen of the coast have given no attention to the capture of these little fish, and seem to have quite forgotten that they were present in any quantities in the waters. Since the erection of sardine canneries a few of the fishermen have been induced to rebuild their weirs, and the herring prove to be fully as abundant now as formerly. Indications lead to the belief that within the next few years a large number of new factories will be built at various points between Eastport and the Penobscot, in which case Eastport will no longer control the sardine industry.

During the season of 1886 herring suitable for canning have been exceedingly abundant all the way from Machias to Deer Isle. The weirs now existing, although in many instances provided with extra "pounds" in which the fish can be kept alive, have in a large number of cases been utterly unable to keep the fish which have entered them.

This large run of sardine herring will doubtless stimulate the westward movement already begun, which will be further strengthened by the strong competition among the eastern factories, which leads them to pay the fishermen a very much larger figure for their fish than the business will warrant. The rivalry among the factories has of late been on the increase, as one can not be contented to remain idle while others are fully employed; and if there is a tendency on the part of the owners of a cannery to withdraw from competition, the workmen become dissatisfied and seek employment in the factories that are more constantly in operation.

Eastport, if we include the villages of Lubec, Pembroke, and Robbinston, only a few miles distant, is still the center of the industry; and while the fisheries farther west are at best only partially developed, those of Eastport and the surrounding islands of New Brunswick are developed to their fullest extent, and a very large percentage, in fact a large majority, of the people, both along the American shore and on the British islands, are wholly dependent upon the sardine industry for a livelihood, some giving their entire attention to catching the fish, others to transporting them, while the remainder are employed in various ways in the canneries.

III.—THE WEIR FISHERIES.

THE WEIRS.—By far the largest part of the fish are caught in brush weirs, which so far as we know are peculiar to the coast of Maine and the Bay of Fundy. These were employed by the white settlers in the capture of herring in this vicinity before the beginning of the present century, having no doubt been copied from those used earlier by the Indians. During the season of 1886 there were on the American shore, between Robbinston and West Quoddy Head, including Cobscook Bay and its numerous branches, 88 herring weirs, besides the salmon weirs of the St. Croix River between Robbinston and Calais; 83 weirs on Deer Island and small adjoining islands; 21 around Campobello Island; 58 in St. Andrew's Bay, and 80 along the Canadian mainland between St. Andrew's Bay and Point Lepreau. There are also 23 weirs within a radius of 8 or 10 miles of Cutler; 46 weirs between the mouth of the Little Kennebec River and Prospect Harbor, supplying the factories of Jonesport and Millbridge, with 46 others around Mount Desert and adjoining islands, supplying those at Bass Harbor, Southwest Harbor, and Lamoine; and 12 from Deer Isle to Carver's Harbor, upon which the factories of Deer Isle and Brooklin depend.

Prior to 1880 the weirs were built in the more sheltered coves, and were comparatively small and inexpensive; and this is true to-day of a large majority of the weirs along the coast of Maine west of Lubec, and also to a greater or less extent of those between Lubec and Robbinston, and of those in St. Andrew's Bay and along the main shore of New Brunswick; but at Deer Island and the other British islands in the vicinity, which are now the center of the herring fishery, the weirs are now considerably larger and more expensive than formerly, being often located on the extreme points of land or even in the deep tide-channels among the islands and ledges. Their average depth is now about 20 feet. Five years ago the average cost of the weirs on Deer Island did not exceed $300 or $400; but later it advanced to $600, and the weirs recently built will average little, if any, short of $800, one or two of the largest and most expensive costing as much as $3,000. Those along the coast, from Cutler to Millbridge, cost about $200 each, besides $75 for the boat and $50 for the seine used in fishing them. Two or three men ordinarily constitute a weir crew on the American coast.

The weirs are as a rule made of brush, the stakes or posts being driven firmly into the ground and strengthened by large horizontal stringers which are securely bolted to them. The portion below low-water mark is closely woven or "wattled" with branches of trees running horizontally, these being pushed to their place below the surface of the water by means of a forked stick. The upper part of the weir is ordinarily of more loosely woven brush placed perpendicularly, the upper extremities extending to a point 2 or 3 feet above high water, and as the rise and fall of the tide averages 20 feet, and in spring tides nearly 30, the amount of material used is considerable. Formerly only pine, spruce, and other soft wood was employed, but in the larger and more exposed weirs hard wood is now almost invariably substituted, and the size of the posts and stringers is considerably increased. Of late some of the fishermen are replacing the brush by heavy netting in that portion of the weir which is exposed at low water.

The principle upon which the weirs are constructed varies considerably, according to the locality in which they are to be placed. The principal forms are known as bar weirs, channel weirs, shore weirs, and patent weirs. The first named is so placed that a ledge runs across its mouth, this being covered by the tide to a depth of 8 or 10 feet at high water, but gradually approaching the surface as the tide recedes and being left dry at half ebb, thus effectually preventing the escape of the fish. Channel weirs are built in the strong currents between the islands and ledges or between the main-land and an island. They have brush wings running out to either shore to turn the fish toward the mouth of the weir, which is so constructed that they find difficulty in escaping. The shore weirs vary endlessly in shape, but in most cases a wing extends diagonally outward for several yards from the mouth of the weir, which is usually just at the edge of the water-line at low water, another often running diagonally from the opposite side of the mouth to the shore, while the shore forms the inner side, the fish being retained in the weir proper, which resembles slightly a semicircle in shape. The patent weir is constructed on a principle similar to that of the pound-nets so extensively employed in the Great Lakes and along the southern shores of New England. It consists of a leader of brush extending at right angles to the shore into 15 or 18 feet of water at low tide, with an inclosure for the fish from 20 to 50 feet across at the outer extremity. Where the bottom is hard and stakes can not be driven ballasted weirs are built. These are similar in form to those already described, but have the stakes strongly secured and braced to a large platform, corresponding in shape to the bottom on which it is to be placed, this being heavily weighted with stones and sunk into place, the stones holding it securely against the current. Nearly half of the weirs built at Deer Island during the present season are of this kind. From year to year the material for building the weirs has become more scarce, and, consequently, more expensive. As a result, the fishermen now usually take out the brush above the line of low water and keep it on shore during the winter, replacing it when the weir is put in order the following spring. A weir properly constructed will last for five or six years, the stakes at this time usually being so badly worm-eaten that they are worthless. They are more or less injured by drifting ice in winter, and considerable expense is incurred in putting them in repair for the fishing season in the spring, the annual expense of repairs being 15 to 25 per cent. of the original cost of construction.

The catch of the average weir can not be predicted with any certainty. It is estimated by Mr. Schroeder, a gentleman well informed on this subject, that not more than one-third or one-fourth of the weirs built during any season will catch fish enough to pay for tending them. Those not successful are seldom kept up more than one or or two seasons, after which they are abandoned. He further states that the few weirs that are successful catch fish only three or four years, after which the quantity taken gradually decreases until it is found desirable to abandon them. After remaining out of repair for a number of seasons they are rebuilt and are often as successful as during the first years of their fishing. Nct half a dozen weirs out of the entire number in the vicinity have fished regularly since the beginning of the sardine industry, and the result is that the fishermen are constantly on the lookout for better privileges, and are moving them about from season to season in the hope of finding better fishing. It is claimed that the number of weirs about Deer Island is not incre asing, but that while new weirs are being built yearly others are allowed to run down, so that the total number remains constantly about the same. This would not be true of the north shore between St. Andrew's Bay and Lepreau, as the weir fisheries there are increasing rapidly.

PROFITS OF WEIR FISHING.—While the catch of some weirs is so small as to be unremunerative, that of others is often very large, and the price paid for herring is such that the majority of the weir fishermen are rapidly improving their financial condition, as shown by both the interior and exterior of their dwellings, and by the character of their boats. The largest catch of which we learn was from a weir in Letite Passage, which stocked nearly $20,000. Another weir, on Adam's Island, recently stocked over $10,000 in one season, while a weir at Deer Island caught $800 worth of herring at a single tide. One weir at Letite Passage, which is now considered the best in the region, is owned by Canadian fishermen, but controlled by Eastport parties, who, beginning with 1886, have agreed to pay an annual rental of $2,000 a year and $3 additional per hogshead for all fish that are taken in it; and notwithstanding these seemingly exorbitant figures, they find it advantageous to make this arrangement, as the catch of this season has been unprecedentedly large, and owing to the high prices at which fish have been selling elsewhere, the difference between their contract price of $3 and the average market rates in the vicinity has been sufficient to very nearly pay the entire three years' rental in advance, thus leaving a handsome profit on the fish that may be caught in the future.

MOVEMENTS OF THE HERRING.—The fish enter the weirs at different times according to their location with reference to the shore. With some weirs it is during the last quarter of flood tide, while with others it is at the beginning of the ebb, though the time of their entrance is almost without exception within two hours of high water. The little herring are said to remain well out in the channels during moonlight nights, and to come in much closer to the shore when the nights are dark. They also swim well in on the flood tide, seemingly feeding upon the marine life that has been left dry by the receding tide and floats about freely as it is taken up by the incoming one. Some of the fishermen claim that they are drawn in by the higher temperature of the water rather than by any increased abundance of food; as the water flowing in upon the rocks that have been exposed to the heat of the sun is raised several degrees in temperature, and the herring find it more agreeable. Whatever be the cause, there seems to be little question that the fish approach closer to the shore on the flood than on the ebb tide, and the weirs are most successful when high water occurs very shortly after sunset or at sunrise. The wind, too, seems to have a greater or less effect upon the catch; and when it blows with any considerable force from certain quarters the fishermen know from experience that they are to get no fish, and hence do not take the trouble to visit their weirs.

FISHING THE WEIRS.—The weirs are fished at low tide, regardless of whether this may occur during the day or night. The fishermen usually go out in their boats about two hours before slack water to see if there are any herring. At night a torch is lighted on entering the weir, and the herring, attracted by it, gather around the boat, thus enabling the fishermen to judge of their abundance. If a sufficient quantity is found to warrant the seining, they proceed at once to the seine-float which is anchored near by, and unreel the seine, stowing it carefully in their boat. They then re-enter the weir and, after making one end of the netting fast to one of the posts, usually at the back or deepest portion of the weir, which varies from 12 to 20 or even 25 feet, row the seine around the fish and bring the two ends together, after which the circle is slowly lessened until the fish are huddled close together in the bunt of the seine, when, by means of large dip-nets, holding several barrels, they are "rolled" into the boat.

It occasionally happens that more fish are caught than can be utilized, in which case it is desirable to keep them alive for a day or two. For this purpose, several weirs are provided with "pockets," which are brush inclosures resembling the weir proper in construction and placed just behind it. The inclosure communicates with the weir by a gate, through which the fish are driven and retained until needed.

Five or 6 men are required to fish the largest weir, and 2 or 3 are needed for the smaller ones. A fair average for the weirs on Deer Island would be 4 men, while those in other localities would not exceed 3, and would possibly fall a trifle below that figure. Several persons usually own and fish a weir together, but where men are hired the price paid is from $25 to $30 per month and board.

THE WEIR-BOATS.—The weir-boats are well built and substantial, ranging from fifteen to twenty feet in length and holding from two to four or five hogsheads of fish. They cost from $50 to $350 each, the average being about $200. The number required for fishing a weir depends wholly upon the strength of the tide and the size and depth of the weir. Some of the largest have 4 or 5 boats, while the average has only 2.

THE REGULATIONS OF THE WEIR FISHERIES BY THE CANADIAN GOVERNMENT.—The Canadian Government exercises a jurisdiction over its weir fisheries. It claims to have entire control of the water below high-water mark, and before a weir can be constructed the fisherman is obliged to obtain a license, for which he pays $5. When the locality of the weir has been decided upon, the fisherman makes out his application on a blank, which requires from him certain information, including the statements that the privilege selected is not within 600 feet of any weir already built; that the building of a weir there will not interfere with the fishing of any weir in the locality, and that it does not interfere either with private rights or with navigation. If considered favorably by the local fishery officer, it is indorsed by him and forwarded to the head inspector for the province, who issues the license in due form. If the place selected has not previously been occupied, the owner of the land is given preference, and is allowed to put up the weir if he desires, but, if he does not care to utilize the privilege, the applicant for same must obtain from him a written statement that he has no objection to his utilizing it. When once the privilege has been granted the man holding the license has preference over any other, and as long as he is willing to pay the yearly license of $5 he can retain it, even though he may not see fit to keep his weir in repair; or, in fact, it is not necessary that he should build the weir, for as long as he pays the license he controls the privilege. It sometimes happens that a fisherman will purchase numerous privileges which he considers valuable and sell them at an advance to his neighbors, though ordinarily the man who takes up the privilege builds and fishes the weir. When for any reason the fishing has been unremunerative, and the fisherman is unable or thinks it inexpedient to rebuild the weir, he is not compelled to pay the license until such time as he finds it desirable to resume active fishing operations. He, however, does not forfeit his right to preference in case a new license is to be granted unless after another application has been made for the same privilege, he refuses to pay the license fee.

PREVENTION OF DAMAGE TO WEIRS FROM MOVING ICE.—Owing to the amount of drift-ice in this locality the weirs are often badly damaged, and sometimes entirely destroyed, during the winter months. A fisherman at Letite has devised a plan for overcoming this difficulty. He selects large fragments of rock, weighing from 1 to 1½ tons each, drills holes in them and inserts eye-bolts. To these the stakes are fastened by means of an iron link in such a manner as to be movable. The rocks, with the stakes attached, are then lowered into position, and the tops of the stakes are connected by means of the horizontal stringers and strengthening stays, after which frames containing the wickerwork are inserted, and the weir is ready for fishing. When the season is over, the brush frames and the stringers and stays are removed, thus relieving the strain from the poles, which are pushed aside by any obstruction that may come against them.

USE OF LARGE WEIR HERRING FOR SMOKING AND BAIT.—The weirs are usually put in order for fishing early in March, at which time herring too large for sardine purposes are abundant, and, while some of the fishermen do not care for them, others save all that are caught, and smoke them or carry them fresh to the smoke-houses at Eastport and Campobello. Considerable quantities are sold to fishing vessels from Gloucester and other fishing towns of Massachusetts and Maine, quite a large fleet of these vessels coming to Eastport and vicinity to purchase their supply of bait at this season.

FISHING SEASON FOR SARDINE-HERRING.—About the middle of April the large herring have disappeared, and smaller ones, suitable for sardine purposes, arrive. By the 1st of May the fishing is at its height, and the fish continue to be abundant about Deer Island (New Brunswick), until June, when the weir fishing in this vicinity becomes less extensive, as the fish distribute themselves in the small coves and bays along the main shore, where they remain during the summer months and are taken in limited quantities by the weirs there. The weir fishing of Passamaquoddy Bay begins to improve early in September. By November the catch is again large, and the fishing continues to be profitable until the middle of December, when the factories are closed. Fish of suitable size may be taken in winter, but they are in poor condition, and the collecting boats are liable to be detained so long by storms, that the fish become stale and worthless before reaching the factories. The packers of Maine were agreed upon the desirability of suspending operations in winter, and through their efforts a law was placed upon the State statute-books requiring the canneries to be closed from December 15 to April 15 of each season. According to Mr. Sellmann, the weir season for herring in Penobscott Bay is from the first of June to the middle of October, while the weirs about Jonesport and Millbridge usually begin catching fish early in May, and the run is practically over by the middle of September.

INTERFERENCE OF SQUID AND MACKEREL WITH WEIR FISHING.—The movements of herring are much interfered with by the presence of squid and mackerel, the former of which is a deadly enemy of the tiny fish, which from experience has learned to keep as far away from it as possible. For the past three years large schools of squid have entered the Bay of Fundy early in July and have remained until the 1st of October. They seem to follow and feed upon the small herring, and effectually break up and scatter the schools. Their presence is a great annoyance to the weir fisherman, as after a school of herring has entered a weir the squid may put in an appearance and drive every fish out, the herring darting quickly through the openings in the brush in order to escape. The presence of mackerel also is injurious to the weir fishing, though to a less extent than the squid. For the past few years they have not been sufficiently abundant to interfere with the fishing to any extent.

IV.—TORCHING AND SEINING FOR HERRING.

TORCHING.—Up to the last two or three years a favorite method of catching the herring was by "torching" or "driving," as it is locally called. This method has for many years been extensively employed by the inhabitants of the region during the winter months for securing herring for smoking, and prior to the passage of the law which forbids the canning of sardines between December 15 and April 15 almost the entire supply of herring obtained during the winter for canning purposes was secured in this way. Torches have long been used in fishing by the savage and semi-civilized races in many parts of the world, and were employed by the Indians of this locality prior to its first settlement by the whites. The white man soon adopted the method and has continued it to the present time.

A 16-foot lap-streak boat, with 4 to 6 men, is required for "driving." An iron frame or basket projects from the bow of the boat, in which is kept a quantity of blazing birch-bark. One man at the stern steers the boat; another, armed with a dip-net, stands at the bow ready to secure the fish, which gather in large numbers, keeping just in front of the light, as the remainder of the crew rapidly row the boat along the shore. It is said that the fish will not readily follow a light in summer, and torching at this season is seldom attempted, but by the last of November the driving begins and continues without interruption until the following spring. Formerly a good many herring were obtained in this way in the vicinity of Eastport, but within the last few years the principal torching grounds have been along the north shores of Passamaquoddy Bay between L'Etang Harbor, New Brunswick, and Lepreau, New Brunswick, and between 8 and 10 hogsheads of herring are often secured by one crew in a single night.

Year by year the supply of birch-bark in the vicinity has decreased, and the fishermen have been obliged to go farther and farther after it. Many of them have of late substituted for it cotton batting saturated with kerosene. This has excited the prejudice of the weir fishermen, who claim that the continual dropping of oil upon the water is liable to drive the fish away from the shore and beyond the reach of their weirs, and a Canadian law which has remained inoperative for some time is now revived, and driving is now practically discontinued,* though possibly the closing down of the canneries in winter has had as much influence upon its discontinuance as the laws upon the Canadian statute-books.

---

* Mr. R. C. Green, one of the leading sardine packers of Eastport, stated in September, 1886, that "the torching has increased a good deal here this season. In the late fall [October and November] the factories are getting a large part of their fish this way."

There seems to be a general impression that herring caught with torches are not so firm and will not keep half so long as the weir herring, but no satisfactory explanation is given.

SEINING.—With the increased demand for herring which the sardine canneries have developed fishermen have exercised their ingenuity to discover new methods of catching them, and, as a result, both the drag-seine and the purse-seine have been introduced. While drag-seines have been extensively employed in the herring fisheries about the Magdalen Islands, on portions of the coast of Newfoundland, and in other localities, they were, as far as we can learn, never used for small herring in this locality prior to 1880, when Mr. McVickers, of Deer Island, purchased a large seine to be used for this purpose. This was tried for several weeks with poor success, and it was finally considered too large and was cut into four pieces, each constituting an independent seine; but for some reason seining never became extensive until the summer of 1884, when, owing to the abundance of the squid, which interfered with the fishing of the weirs, seines were generally resorted to, and, during the months of September, October, and a part of November, nearly the entire supply of the factories was derived from this source. As the few haul-seines used in the locality were very successful, the weir fishermen could not resist the temptation to tie two or three weir seines together and use them for the same purpose; and catches of 50, 75, and even 100 hogsheads of herring were frequently made by them with this apparatus.

During the past two autumns there have been at least 50 or 60 seining crews, averaging 5 or 6 men each. The seining was done chiefly in the early evening. The seines were loaded on large boats and kept in readiness for use at some convenient point. The men would then row into the little coves along the shore and light a torch to see if the herring were there, and if a school was found the seine would at once be brought and the fish surrounded and hauled into the shoal water near the beach, when they would be quickly transferred to the boats by means of dip-nets.

The principal seining grounds were in St. Andrew's Bay, Back Bay, and farther east along the main shore to Point Lepreau.

The average seine used in this fishery is from 30 to 50 fathoms long, 30 to 40 feet deep, and 1 to 1¼ inch mesh; but the length of any seine can easily be extended by adding one or more weir seines to it when necessary.

With so large a crew of seiners and a large fleet of collecting boats following close behind them, the excitement was considerable, and frequently several hundred men with a large fleet of boats would be collected in one locality. The noise and confusion resulting was used as a pretext by certain of the more successful weir fishermen whose income from fishing during the summer was so large that they did not care to engage in seining. These drew up a petition, representing that the rights which were granted them by the license to fish their weirs, and for which they paid the Canadian Government, were being interfered with. • This petition was met by another from the less fortunate weir fishermen, who were glad to improve the opportunity for catching and selling the herring which they had not been successful in securing in their weirs during the earlier months. The Government finally decided that as weir fishing had become an established industry, and a considerable amount of capital had been invested in it, any methods of fishing that would in any way break up the schools of fish, or interfere to any extent with the catch of the weirs, ought not to be encouraged, and they therefore decided to prohibit it. This regulation first went into operation in August, 1886, and at the present time (September 6) the fishermen are uncertain how rigidly it will be enforced. The owners of the canneries are very anxious that seining should be continued, as without the seine-fish they think the supply will not be sufficient to keep their employés work. •

Some years ago there was a strong feeling of opposition on the part of the shore line and net fishermen of the State of Maine to those engaged in catching menhaden for use as oil and fertilizer. They finally succeeded in getting a law passed to prevent the further fishing for menhaden in that State. The law was framed so as to prevent evasion if possible, and the fishermen now find that it was so worded as to include not only menhaden, but mackerel and herring, and that purse-seining was not particularly specified, but that the broader word, seining, was used, so that the American fishermen, as well as the Canadians, are prevented from catching herring in this way. A recent attempt on the part of an American fisherman to seine herring in Cobscook Bay resulted in the seizure of both seine and vessel.

After the haul-seines had been successfully introduced the proprietor of one of the canneries decided to try a purse-seine. A seine 250 fathoms long by 12 fathoms deep in the bunt, of 1¼-inch mesh, and a small seine-boat, were ordered. On the arrival of the seine it was loaded into the boat, which was taken in tow by the small sail-vessel that cruised about in search of herring, the sardine-boat following after to carry away to the factory any fish which might be taken. The crew consisted of six men, one or two of them rowing about in a small boat in search of the herring, while the remainder staid on the vessel, waiting a signal that the fish had been found. When a school was discovered the seine was set around them and the fish were secured. It occasionally happened that the fish were in too shallow water to warrant the pursing of the seine, in which case it was used as an ordinary haul-seine for dragging the fish into shoaler water. On several occasions as many as 50 hogsheads were obtained, while the average haul was from

10 to 25 hogsheads. There are at present four purse-seines owned in the vicinity of Eastport, but the law which forbids the use of haul-seines prohibits these also, and none of them are employed at present.

V.—TRANSFER OF HERRING FROM THE WEIRS TO THE CANNERIES.

UNIT OF MEASURE.—The unit of measure for sardine herring is the hogshead, equal at Eastport to five flour barrels or fifteen bushels. The fish are measured in baskets holding a bushel and a half, ten baskets constituting a hogshead. Farther west a somewhat larger measure is employed, the basket holding about a bushel and three-quarters, ten of them being counted as a hogshead.

THE COLLECTING-BOATS.—Formerly the fish were brought to the canneries by the men who caught them, but the desire of the canners to secure the largest possible quantities led them to introduce the practice of sending for the fish, which has since become universal. A fleet of one hundred and twenty-five boats, with about two hundred men, are now regularly employed in collecting and running them to the factories. Some of these boats are very large, strongly built, and suitable for any weather, while all are well built and substantial. They average from eighteen to twenty-five feet in length, and readily carry from six to twenty hogsheads of fish. All have holds in the center, covered with hatches, to protect the herring from the sun and from the water. The largest ones, sailed by two men, are worth about $1,000; while the smallest, worth $125 or $150, are easily handled by one man. The average for the whole fleet would be about $275 to $300.

A majority of these vessels belong to men living on the Canadian shore, in the vicinity of the weirs, though quite a number are owned and manned by Eastport parties.

PRICES OF FISH AND WAGES OF FISHERMEN.—Some hours before the weirs are to be seined, the collecting-boats start out and make a circuit of the shore, for the distance of a mile or more, to see which contain fish.

They usually select those having the largest quantities, and remain there until the herring have been taken out. The boatmen act as agents for the canneries, with instructions to purchase the fish as cheaply as possible. When the boats from several canneries meet at a weir, the fishermen find it advantageous to put up their fish at auction and sell them to the highest bidder; and rivalry between the boatmen usually leads them to bid until they have reached the extreme limit named by the factory, and the one who can afford to pay the highest price takes the fish. From personal motives they are also interested in securing as large a quantity of fish as possible, regardless of the price which they are required to pay, as their salary now depends largely upon the quantity of fish obtained. Formerly the boatmen were employed at wages ranging from $50 to $60 a month for the man and boat, and in the case of the largest boats the factory employed a man or a boy to assist him. By this arrangement there was no stimulus for the fishermen to be on hand promptly when the weirs were seined, and the more faithful and energetic ones thus secured the bulk of the herring. By way of reward for faithfulness the wages were changed so that the boatmen should receive about $30 per month, with about 50 cents additional for each hogshead of fish landed; and some of the factories now make a practice of paying no stated wages, but give the boatman $1 for each hogshead of fish obtained.

During the season of 1885, the owners of the canneries organized an association for the purpose of regulating the price both of fish at the weirs and of the manufactured product, and held a meeting each week to confer regarding proposed changes. The average price for the season, prior to November, when the compact was broken, was about $5 per hogshead. From this date, when the canners ceased to be under obligations to restrict themselves to certain figures, the price of fish advanced enormously, and as high as $30 was frequently paid, while in exceptional instances the rivalry was so strong as to cause them to bid upwards of $100 per hogshead on small lots. As the majority of the fish were bought at the lowest figure named, the average price would be between $6 and $7.

The present season the packers have acted independently, and the fish have varied in price from $2 to $30, averaging between $8 and $10. The price can never fall below $2, and ought not to go below $3, for if the herring are of good size, the fishermen can sell them for about that price to the herring smokers, or, as many of the weir fishermen own smoke-houses, they could utilize their own catch. They are probably worth at least $2 a hogshead for use in the manufacture of oil and fertilizer.

METHODS OF COLLECTING THE FISH.—As soon as the fish have been purchased, the boats start immediately for the cannery, as a few hours will suffice in warm weather to render the fish worthless, while even in winter they ought not to be heaped together in any considerable quantities for more than ten or twelve hours. During the summer months the boats are often so long delayed by calm weather that their fish are injured and perhaps rendered worthless for canning purposes. To overcome this difficulty, a small steamer is employed in towing the collecting boats to the canneries, the owner receiving 50 cents per hogshead, in addition to the price paid to the boatmen, for each hogshead of fish contained in the boats which he assists. The boatmen, however, are supposed to depend upon their sails when they have a fair wind, and to accept a tow only when they consider it necessary in order to insure the arrival of the fish in good condition. At Jonesport a small steamer is employed by one of the canneries for collecting the fish, these being placed in baskets and carried in the hold of the steamer, and one of the canneries at Robbinston also owns a steamer which is employed in a similar manner. At Eastport and Lubec all of the fish are now brought in by collecting boats, but at Robbinston, Pembroke, and places farther west a large percentage of the fish are brought in by the men who own and fish the weir.

The greatest distance that the young herring are carried is about 20 miles, and under ordinary circumstances 15 miles is as far as they can safely be taken. The fishing for any particular factory is therefore limited to this radius.

PROPORTION OF AMERICAN AND CANADIAN FISH CONSUMED.—As already stated, the principal fishing grounds for herring that have thus far been developed are among the Canadian islands in the vicinity of Eastport, but the duty of $2.50 per case on sardines prevents the building of factories on the Canadian side of the boundary, these being located, with the exception of a small one at Saint Andrews which is engaged in packing fish for the Canadia trade and for exportation, on the coast of Maine, in close proximity to the boundary line.

The factories at Robbinston have always obtained a considerable percentage of their fish from weirs located along the adjacent coast of Maine, and the present season between 50 and 60 per cent. of the entire pack of these factories has been caught in American waters. The canneries at Eastport are more extensively dependent upon foreign fish than those of any other locality. In 1885, at least 95 per cent. of the fish packed were caught in the waters of New Brunswick, and this year about 90 per cent. were caught in the same locality. The quantity of Canadian-caught fish put up in Lubec and Pembroke varies from year to year. In 1885 at least 90 per cent. of the pack at the former place were caught by New Brunswick fishermen, and fully two-thirds of those caught in the latter were from the same locality. During the present season, however, the catch in the American weirs of Cobscook Bay and of West Quaddy River has been much larger than for a number of years, and it is estimated that half of the pack of the Lubec factories consists of American-caught fish, while at least 90 per cent. of those packed at Pembroke were caught within a few miles of that village. All of the fish put up in the factories farther west were caught along the coast of Maine.

VI.—THE CANNERIES AND THEIR PRODUCTS.

DESCRIPTION OF CANNERIES.—The buildings used for sardine canning are two-story wooden structures, usually containing separate rooms for each of the principal kinds of work. Their value, including the land occupied and all the fixtures which they contain, ranges from $2,000 to $24,000. The largest and best constructed are, generally speaking, those of Eastport, which average nearly $10,000; those of Lubec being worth only a little over $6,000 apiece, and those of Pembroke. Robbinston, and North Perry about $5,000. Farther southwest there is great variation in the size and completeness of the different factories. There are several large ones, notably at Millbridge, Bass Harbor, and, Brooklin, which bring up the average for that section to over $9,000. The canning capacity, though of course dependent largely upon the size of the building, is much increased by the use of ovens and other improvements. The canneries at Eastport can put up, on an average, something over 200 cases of sardines daily; those of Lubec, about 170; those of Pembroke, Robbinston, and North Perry, from 100 to 125, and the western canneries about 180.

The buildings are of an inflammable nature, especially when, after long use, their floors have become saturated with oil, and the employment of fire is necessary in many of the operations connected with the canning. By these causes the danger of conflagration is much enhanced, and the rate of insurance is correspondingly high. The best built factories obtain their insurance for 4 per cent. premium, but many have to pay as much as 6 per cent.

METHODS OF PREPARATION.—The different modes of preparing sardines in use up to the year 1880 have been minutely described in a previous report on this subject.* The following is an outline of the process which the little herring undergo, with a note of the principal changes which have taken place since the date named:

On coming to the factory they first pass through the hands of the cutters, who remove only the heads and viscera, as it is no longer customary to cut off the tails. After this they are left in brine from fifteen minutes to three-quarters of an hour, according to their size, before being placed upon the drying flakes. The cutters are usually small boys, and the flakers women or girls; but in some cases both operations are performed by the same persons.

Sometimes the fish are dried in the sun, but, owing to the dampness of the atmosphere and the frequent periods of cloud and rain, even those factories which make use of this method whenever possible are obliged to supplement it by artificial ones. The factories are, one after another, discarding entirely the sun-drying process, occasionally depending entirely upon the drying-room, but more frequently adopting a patent drying apparatus or the oven. Sometimes the drying is done by heat from steam-pipes, but this is not thought to be so good as the stove-drying method. The condition of the air has considerable effect upon the drying, especially when it is done by natural heat; the dried fish are in damp weather much less firm in flesh than under other circumstances.

The time taken for the drying varies considerably. In the sun or in a drying-room it may take the greater part of a day, in a furnace-heated drying apparatus two to seven hours, and in an oven only a few minutes. The use of ovens has grown much more common during the last year or two, and nearly half of the Eastport canneries, as well as most of those at Lubec and Millbridge, are now fitted with them.

***Fisheries and Fishery Industries of the United States. History and Methods of the Fisheries. Section V, Volume I.* Quarto. Chapter on the Sardine Industry, by R. Edward Earll, pp. 489-524.

When the fish are oven-dried they need no further cooking before being packed, but in other cases they are fried in oil at a temperature of 260° Fahr., the oil being boiled either by direct furnace heat or by the passing of steam through coils of pipe in the frying tank. The Brooklin Canning Company claims to have invented the process of frying by steam, which has many advantages over the old method of direct furnace heat. They produced the first successful apparatus for the purpose in 1884. Experiments had been made by other parties at an earlier date, but without satisfactory results. About a third of the factories which fry their fish do so by means of steam, and, as is the case with other improved methods, the number is on the increase.

It is doubtful whether the ovens will ever supplant entirely the frying apparatus, for it is said that the fish which have been fried have a better flavor, and, having absorbed more oil, keep longer than the others. It is claimed, however, by those using ovens, that by the baking process very much depends upon the skill of the baker, and that, when at its best, it may produce results equal, if not superior, to those of the old system. It appears that the first fish fried in a given quantity of oil are better than the best baked fish, but that as it is necessary, in order to keep the expenses within reasonable limits, to use the same oil for frying successively a great many pans of fish, the fluid soon becomes filled with scales and small particles of fish, which burn on the bottom and impart to the product a bitter and unpleasant taste. In baking, on the other hand, when it is properly done, the fish are all of a quality equally good.

After coming from the frying-pans or the oven the fish go into the hands of the packers, who are almost invariably women or girls, by whom they are sorted and placed in the boxes, which are then filled with oil, or, in some cases, mustard or spices. A few years ago, although other oils were used in the frying, the sardines were packed in olive oil, either alone or mixed with inferior kinds; but at present its use has been almost entirely superseded by cotton-seed and nut oils. This change is accounted for by the facts that the heavy duties make olive oil very expensive, that it will not keep as well as the cotton-seed oil, and that the latter can be made exceedingly palatable. Peanut oil, which is sometimes used, is said to be even better than the cotton-seed oil. The olive oil used in France for sardine packing is often largely adulterated with American cotton-seed oil, as well as with palm and other oils.

When the herring are of the most desirable size they are packed with a dozen in each can; the number is never smaller than seven or eight.

The making of the tin cans or boxes in which the products are packed is quite an important branch of the work at the cannery. Two sets of men are employed, the can-makers who manipulate the machines by which the tin is cut, bent, and stamped into the various shapes and sizes required, and the seamers, who, with a soldering-iron, join the ends together and insert the bottom. In some of the factories solder wire is used for this purpose; in others, the old-fashioned stick-solder is much preferred. Some of the small factories do not make their own cans, but purchase their supply from one of the larger ones.

After the cans have been filled with fish they go to the sealers, who solder on the covers, making them perfectly air-tight. The filled cans are then ready for bathing, and are placed in boiling water, where they are allowed to remain for about two hours.

It was formerly considered necessary to puncture all the cans after the bath had been completed, to allow the remaining air to escape, the aperture being then closed with solder. It has been found that by the use of slightly concave covers this necessity may be done away with, as all of the air is driven out in sealing, and the custom has now become obsolete in the case of cans of the ordinary quarter size, though it is still adhered to in the treatment of the half and three-quarter cans.

Formerly all of the sardines packed on the American coast were sold under French labels, but the better practice of using American labels, showing by what firm they have been put up, is now rapidly gaining ground. This has been brought about principally by a law recently enacted by the New York legislature, forbidding the sale in that State of any canned goods not bearing the name of the maker. The fish sold under honest labels are of better quality than those pretending to be of French origin, as the factory owners allow only their best products to go upon the market under their firm name, and pack the stale or broken fish under the fictitious French labels which do not throw upon them any responsibility.

The description given above of the methods of preparation applies equally to all the different brands of sardines properly so-called. The favorite variety is the "quarter oil," the smallest sized can of oil-packed fish. When the fish are too large for use in this way, they are put up in half-pound cans, or much more frequently, with mustard in the place of oil, in three-quarter cans. Occasionally three-quarter cans of oil sardines, half cans of mustard sardines, three-quarter cans in tomato sauce, and half or three-quarter cans in spices are put up, and in rare instances small fish are put up in mustard or spices in quarter cans.

In 1885 the pack of oil sardines was smaller than usual owing to the scarcity of small fish suitable for quarter cans. A few experiments have been made in the canning of smelt as a substitute for herring in the manufacture of sardines, but they were found to be dry and hard, and deficient in flavor, and efforts in this line have been discontinued.

Two or three factories still retain the practice of putting up a few cans annually of large herring in cans bearing the trade name of "brook-trout," but as this brand has never been received with any favor, the quantity put up has been decreasing year by year.

The manufacture of Russian sardines is still an important part of the business. They are made of fish of a size somewhat larger than those usually canned in mustard or spices. In this way the canneries are able to utilize the large fish which otherwise would have to be used in the manufacture of oil and fertilizers. They are first washed and salted, after which they are packed in fish-barrels and shipped to New York for repacking and further preparation. In this condition they will not keep more than two months. The barrels are worthless in New York, and at least one firm in Eastport saves that item of expense by preparing its own Russian sardines for market. The process consists in packing in wooden kegs or pails containing about 4 quarts each, where they are well covered with whole spices, including cloves, allspice, mustard seed, and pepper, with a liberal allowance of bay leaves. A quantity of vinegar is then added, the package is headed up, and it is ready for use; but it is considered better after it has been in stock for some time and the fish have been thoroughly flavored by the spices.

We were informed by one of the factory owners that Russian sardines of American make were going out of the market, as the foreign were much preferred, but comparative figures for 1885 and 1886 show a considerable increase in their manufacture during the latter year, and the importation is steadily decreasing.

CHANGES IN MANUFACTURE SINCE 1880.—The principal changes in the methods of preparation since 1880 may be summed up as follows: The tails of the sardines are not removed; the stove-rooms are more complete, and there is less drying in the sun; much of the frying is now done by steam instead of by furnace; ovens are used in many factories instead of frying apparatus; a concave cover has been substituted on the quarter cans for a flat one, so that it is no longer necessary to vent them after bathing, and American labels are placed upon the most creditable fish instead of the foreign ones universally used several years ago.

COST OF PREPARATION.—With fish at $6 per hogshead the actual expenses incurred in putting up a case of 100 quarter cans of oil sardines amount to from $3.75 to $4, divided approximately as follows: About 40 cents for fish, 40 cents for oil, $1.20 for tin, 60 cents for solder, 10 cents for the box, 8 cents for salt and coal, 5 cents for miscellaneous items, and $1.17 for labor.

As remarked in an earlier portion of this report, the price of fish varies considerably. It averaged about $7 per hogshead in 1885, and $9 in 1886. From one hogshead of fish an average of about 16 cases of quarter cans or 13 cases of half cans may be put up, the extremes varying from 12 to 22 cases according to the condition of the fish. From a gallon to a gallon and a quarter of oil, at 40 cents a gallon, is required for each case.

The tin of which the cans are made is usually got direct from England, but in some cases is bought in New York. Three cases of tin are used in making 20 cases of cans, one for the sides, one for the bottoms, and one for the covers. The duty on tin is $1.12 a case. The bronzing of the tin and the stamping of the label upon it are done in New York. The tin is first printed and then baked. Six firms are engaged in the business, three of them devoting their entire attention to supplying the sardine canneries.

The solder used in putting together the cans and sealing the covers is a mixture of pig tin and lead in equal proportions. The amount used varies according to the skillfulness of the employés who handle it. In sealing, for example, the poorest workmen will use 2 pounds and 13 ounces for a case of cans, while the best will not exceed 1 pound and 15 ounces. The average amount required for each case is 4½ to 5 pounds, including something over 2 pounds for sealing. A cannery will often use more than 100 tons of solder during a single season.

The expenses of operating a cannery are, as may be readily seen, very great, and it is therefore necessary in most cases for the factory owners to turn over their working capital several times in a year. This is illustrated by an instance where a factory with a cash capital of $8,500 pays out $52,000 a year.

WAGES PAID.—The cost of labor amounts to from a fourth to a third of the entire expenses of a cannery. The price of labor is lower and less variable in the factories outside of Eastport. A large percentage of the operatives employed in the industry of that town are young persons of both sexes, who come from their homes in the neighboring portions of the Provinces, to which they return at the close of the season. The factories being so numerous there is considerable competition for labor among the factory-men, who, when there is a rush of fish, bid against each other for the services of the workmen, who go wherever they can get the best pay. When fish are received by any factory the cutters and flakers are summoned by a steam whistle, each cannery having a signal peculiar to itself which is easily distinguishable from that of any other.

The following is a schedule of the average wages paid by the Eastport factories. A working day for ordinary labor is ten hours, and those who are paid by the day receive extra remuneration for every hour's work which they do in excess of that time. Skilled laborers are usually employed at piece-work or by the hour. They are, as a rule, occupied only a few hours each day, as they do not assist in the general work of the cannery, but return to their homes after their special work for the day is completed.

Boatmen.—Formerly $50 to $60 a month; now $1 per hogshead, or $30 per month and an additional 50 cents per hogshead.

Cutters.—Paid by the box and average ordinarily $5 to $6 per week, or, when the factories are working full time, $2 or more per day. Sometimes when fish are abundant they will make very large wages, and a child of twelve or thirteen years will occasionally earn from $18 to $20 a week. If the cutters had all that they could do, they would earn more than any other class of employés. This results from the fact that the principal competition is for this class of labor, for if the cutters are not on hand in sufficient numbers immediately after the fish arrive the whole lot may be spoiled before they can be cared for.

Flakers.—Usually 10 cents an hour.

Packers.—One dollar and a quarter for the first three hours' work, or 10 to 12 cents a case. The best workmen pack at least 20 cases in a day of 10 hours, and earn $10 to $15 a week under ordinary circumstances.

General laborers and bathmen.—Two dollars per day and 20 cents an hour for overtime.

Seamers.—One dollar and a half to two dollars per day, or 6 cents per 100 cans.

Can-makers.—Fifteen to twenty cents per hundred cans. In some cases the combined wages of the seamers and can-makers amount to 30 cents a case.

SHIPMENTS AND MARKETS.—Many of the factories are owned or controlled by New York firms, and most of the others have permanent arrangements with some particular dealer, who acts as their agent in placing their goods upon the market to the best advantage possible. Others sell through various brokers, and it is now becoming a common practice for wholesale grocers to speculate in sardines and order their supply directly from the canneries. All the regular agents for the Eastport canneries, as well as most of those for the ones at other places from Mount Desert Island eastward, have their headquarters at New York City; but the canneries on Deer Island and at Brooklin ship to Portland and Boston. The products are usually shipped by steamer, but sometimes go to New York in sail vessels. The price received for quarter oils in 1885 was from $4.50 to $7 per case, averaging $5. The average prices in 1886 were, for quarter oils, $4.50; half oils, $7; quarter mustards, $5.50, and three-quarter mustards, as well as the brands prepared with tomatoes and spices, $3.50. Russian sardines sell for 45 cents a keg, or 13 cents less than the imported article.

When a shipment of canned goods is made to the New York dealer it is customary for the firm owning the factory to draw a certain amount from him on its bill of lading. The dealers then, according to the nature of their instructions, either sell as soon as possible or hold for better prices, transmitting the balance due the factory as soon as the sale has taken place. When the market is known to be poor the shipment of goods is often delayed until a more favorable opportunity arises for disposing of them to advantage.

In the spring of 1885 there was a stock of between 140,000 and 150,000 cases on hand at the factory; but in 1886 the season opened with a stock of only 40,000 cases.

The combination entered into by the factory owners in 1885 resulted in considerable profit, controlling, as it did, the prices both of fish and of goods; but the best-established firms got the most trade and succeeded in obtaining the largest share of fish. It was finally broken up by certain wealthy weir fishermen of Deer Island, who, seeing their profits curtailed by the fixing of a uniform price for their fish, put up a factory near Eastport and began independent operations. This factory, refusing to enter the combination, and paying for the fish more than the price fixed by the exchange, caused the other factories to break their agreement and renew the competition. As the run appeared to be light, they bought at exceedingly high figures, but the supply of fish kept up all summer and the business suffered from over production.

There is some foreign trade, the American factories supplying Canada and shipping 6,000 cases a year to South America. The brand most commonly placed upon the Canadian market is the half-pound can of sardines in mustard, as the duty is proportionately much less than that upon the quarter-oils. Several lots have been sent to Australia, but the last shipment resulted in loss on account of the serious competition of the English sprat sardines, which prevented further exportation to that country. The business of preparing sprats in the form of sardines began in England three years ago. The headquarters of the business were in the vicinity of Dover. Several thousand cases of this variety of sardines were sent to the United States a year or two ago, while the price of the American product was comparatively high; but the American firms fear no further competition from this source as long as they are able to place their goods upon the market at anything like the present figure. With the existing tariff it is impossible to import the British sardines at a cost of less than $7.75 per case, while those of American preparation are offered in London at 19*s*., equivalent to $4.60. The French sardines are unquestionably superior to the best which we have thus far produced, but the price is so much higher that the American article is usually preferred.

DEPENDENCE OF EASTPORT AND SURROUNDING COUNTRY ON THE SARDINE INDUSTRY.—All of the large amount of money required for carrying on the sardine business of Eastport, with the exception of that used in the purchase of tin, solder, and boxes, is expended locally, going either to the residents of the town or to the neighboring islands. Since the development of this industry the population of Eastport has increased 50 per cent., notwithstanding the failure of other means of livelihood which had formerly been the principal dependence of the inhabitants; and the Calais trade is visibly affected by the prosperity of the factories.

The Canadian islands and shores within a wide radius of territory depend entirely upon the canneries on the American side. The people give most of their attention to fishing for the small herring with which to supply the factories; and their children are employed as factory-hands for eight months out of the twelve. The "sardiners" as a rule spend their money as fast as they earn it, so that probably not 10 per cent. of the total amount which they receive in wages goes back to the islands with them in the fall.

VII.—INTERNATIONAL AND ECONOMIC QUESTIONS INVOLVED.

EFFECTS OF TERMINATION OF TREATY OF WASHINGTON.—During the last few years of the continuance of the Treaty of Washington the sardine interests developed with surprising rapidity. With the termination of that treaty grave fears were entertained on the part of all concerned lest the business might be so seriously interrupted as to render it unprofitable. The Collector of Customs at Eastport, appreciating the importance of the situation, gathered statistics to show that the magnitude of the industry warranted the Government in giving special attention to its interests, and wrote a detailed letter explaining the situation, which was the natural result of an industry in which the citizens of both the United States and Canada were equally interested.

A considerable percentage of the herring were caught by fishermen living on the Canadian side of the boundary, while the entire packing interest was controlled within the limits of the United States; hence any regulations which interfered with the bringing in of fish would result disastrously to both parties. He explained that for many years the fishermen had been accustomed to go out in their small boats and fish with trawl and line indiscriminately in British and American waters, bringing their catch home to be salted and sold. He then asked whether these boats, which were of less than 5 tons burden and hence not recognized as vessels, could not for purposes of fishing be considered as vessels of the United States, and their catch, when manned by American citizens, be admitted free of duty as the product of the American fisheries, even though the fish might have been caught in Canadian waters. This question, if answered in the affirmative, would allow the few boat fishermen that remained to continue their fishing without interruption, and would remove difficulties which would otherwise prove annoying.

A second question was submitted asking whether American boats manned by American citizens would be allowed to go to the weirs and to the fishing grounds along the Canadian shores, and obtain fish caught there, and bring them home in said boats free of duty as the product of the American fisheries. The Secretary of the Treasury submitted the questions to the Attorney-General, who decided both in the affirmative.

These decisions having been made, it was in the power of the Collector to make such minor arrangements as were necessary for continuing the business. A large percentage of the vessels employed in transporting sardines from the weirs to the factories were owned by men living on the Canadian side, but as their boats were open boats of less than 5 tons burden, and hence not recognized by the United States as vessels of a foreign country, they would be treated as wagons or other vehicles for transportation, and could be brought to Eastport, entered, appraised, and duty collected, after which they would be regarded as American boats. At least seventy of these boats were thus made over into

American boats, and such of their owners as could be naturalized took out the necessary papers and became American citizens, while others disposed of their vessels to Americans or employed Americans to navigate them. Thus the business went on without serious interruption, and the canneries were allowed to obtain their supply of fish without the payment of duty, which would amount to between $5 and $6 per hogshead.

ACTION OF CANADIAN GOVERNMENT.—The disposition of our Government to deal generously with the industry was in marked contrast with the early action of the Canadian government, which, after the boats had been made over into American craft, and had paid a duty of 35 per cent., raised the question whether these boats, having been Americanized, should continue to have the same privileges as were accorded to English boats; and an effort was made to break up the general trade which had for half a century been carried on between Eastport and the islands. Eastport being the natural market for the islanders they had been in the habit of coming here in their boats to obtain flour, sugar, dry goods, and such other things as were needed by themselves and families. The government agent worked up several cases against the inhabitants of the islands; in one case where a fisherman had bought boots worth $4, demanding $50 in settlement; in another where one had purchased cloth for a sail for his boat, settling for $25; and numerous other cases of a similar character were compromised. Later an agent was sent into the locality to inquire into the influence of hostile legislation upon the New Brunswick weir fishermen, and into the practice of allowing the selling of herring to the boats that had been entered in the United States and thus become American. It was finally decided that should the government interfere in any way with this arrangement it would result in serious loss to their own fishermen, and they concluded to allow the practice to continue, but required that these boats should enter and clear at the custom-house when coming for their cargo. The perishable nature of the small herring rendered compliance with this regulation impossible, and it was later decided by the customs authorities that the boats could get their load of herring and then come to the custom-house and enter and clear at the same time; but as the fish were often obtained at night, when the customs offices were closed, and to wait for morning would cause the entire loss of the fish, the customs regulations were finally amended so that the boats could come once a week and obtain permits, or in other cases permits were issued lasting a week or authorizing the conveyance of a stated quantity of herring. The English boats were also required to carry papers, in order that they could be distinguished from those belonging in the United States. This practice has continued and the officials have ceased to be very stringent in insisting upon the regulation, until now many of the boats go to the custom-house only when they find it convenient. An officer from the Canadian cruiser stationed in the locality frequently boards the boats and asks for their papers, but in no case, thus far, has any sardine-boat been seized, though two or three were warned out of St. Andrews Bay during the early part of July.

The customs officers on this side have been as lenient as the law would allow, not being disposed to cause any trouble or annoyance; and it was not until the Canadian cruiser had seized two boats belonging to semi-professional fishermen, who had been engaged in catching pollock for their own use, that very careful scrutiny was made of the sardine-boats to know whether they had entered and paid duty, or whether they were still English boats. On September 4 a fisherman of Leonardsville, Deer Island, brought a quantity of herring to one of the canneries in an English boat, and the collector of customs, ascertaining the facts in the case, required him to either pay duty or take the fish back. As he could not afford to pay the duty, he carried the fish home and threw them away.

PRESENT NEEDS OF THE SARDINE INDUSTRY.—Both the canners and the fishermen seem fairly well pleased with the present arrangement, though several of those engaged in the general fishing business urge that it would be much better if some arrangement could be made whereby fresh fish that had not been preserved in any way, either by salting, freezing, or other process, should be admitted free of duty. Others contend that all that would be necessary would be to allow herring for canning purposes to enter free, regardless of whether they were brought in American or English boats. This would enable fishermen getting small quantities of fish, when no collecting boat chanced to call at their weirs, to take their fish to market. Under the present arrangement, as they can not bring their own fish to the canneries, they are obliged to lose them, and the factory hands in turn lose the amount that they would otherwise receive for packing them.

PROBABLE EFFECT OF COLLECTING IMPORT DUTIES ON CANADIAN FISH.—The canners differ as to the probable result of the collecting of a duty of half a cent per pound on fish for canning purposes. Those at Pembroke and at points along the coast of Maine west of and including Cutler, would be benefited if the duty should be imposed, as they would be able to get their fish free out of American weirs and thus easily undersell their Eastport rivals. The Eastport packers naturally oppose the collection of a duty which they claim would, at the schedule rate of half a cent per pound, be excessive, as it would be equal to about 100 per cent. of the actual value of the fish. A hogshead of herring is estimated to weigh between 1,000 and 1,200 pounds, which, at half a cent per pound, would bring the duty up to between $5 and $6. When we take into consideration the amount of waste in stale fish which can not be used for packing, and in large fish which must be thrown out or used for other purposes, and the other species which get mixed in with the herring, the duty on a hogshead of fish suitable for canning would probably be increased to nearly $8. They claim that if any duty is levied it ought to be reduced so as to be in fair proportion to the value of the fish. Others claim that it would make little difference, aside from the influence of the cheaper fish put up farther west, and as, in their judgment, the quantity of fish there is not sufficient to supply the demand for sardines, the Eastport canneries could still continue at a fair profit. The result of a duty of half a cent per pound would be that the canneries could never get fish at less than $8, while the average cost would probably fall little, if any, short of $10, for the fish are worth $2 or $3 at least per hogshead for smoking or for the manufacture of oil and pomace, and the fishermen would not seine their weirs unless the fish should net them as much as that. Some of the canners who are interested in other fisheries claim that they would much prefer to pay a duty on herring to be used for canning purposes than to throw open our markets free to Canadian fish.

The effect of a duty would unquestionably prove disastrous to the New Brunswick fishermen, as it would have a tendency to cause our own fishermen about Eastport to build a larger number of weirs, and would further develop the fisheries to the westward, where to all appearances there is a much larger quantity of herring than is generally supposed. This would lead to the building of factories there, and would in time probably cause the factories at Eastport to suspend operations, thus resulting in serious loss to the town, and of the greater part of the fixed capital now employed in the industry.

There is a natural limit beyond which the price of American sardines can not advance, for the English canneries have an abundant supply of sprat, and with the cheaper labor and the absence of duty on tin and on olive oil they are enabled to put up fish and import them into the United States, paying the duty of $2.50 a case, at $7.75 to $8.25 a case, and these, being equal if not superior to the American sardines, would naturally drive our goods out of the market if for any reason the price of same should advance beyond that figure. During the last three years at least 10,000 cases of these goods have been imported; but the unusually low price of American sardines during the present season has checked this importation, and no sprats have been imported for some months.

The price of the lowest grade of French sardines is seldom below $10.75 to $11, including the duty of $2.50 per case on the quarter oils and $4.50 to $5 per case on the larger sizes. Were it not for the English sprat we would still be enabled to manufacture and sell at a considerable advance on present prices.

Another argument used by canners in favor of the admitting of herring for canning purposes free of duty is that these fish are practically raw material, and that about one-third of their value when canned represents the labor required in putting them up.

They further argue that if the fish were subject to duty it would be impossible, owing to the nearness of the factories to the Canadian border, to prevent smuggling to a greater or less extent by those so disposed, and that the factories doing a legitimate business would thus be placed at a great disadvantage.

All parties are agreed that the removal of the duties on the manufactured sardines of $2 50 per case would result in the transfer of the business from Eastport to New Brunswick, which would throw the labor and profit of the business into the hands of Canadians.

VIII.—STATISTICS OF THE INDUSTRY.

Table showing by towns the number of persons employed in the American sardine industry in 1886.

Location of canneries.	No. of canneries.	Total number of persons employed.	Sealers and can-makers.		Packers.		Cutters and flakers.		General laborers.	Smackmen.
			Sealers.	Seamers and can-makers.	Male.	Female.	Male.	Female.		
Robbinston	2	132	19	16	......	23	30	10	21	3
North Perry	1	62	10	10	......	10	12	8	10	2
Eastport	19	2,146	440	292	......	332	306	261	354	101
Pembroke	2	113	15	5	......	22	21	15	25	10
North Lubec	4	251	47	17	......	56	47	32	43	9
Lubec	4	374	55	49	......	77	64	55	54	20
Cutler	1	161	36	....	......	35	39	26	20	5
Jonesport	3	269	40	28	......	43	69	47	35	7
Millbridge	2	229	33	27	......	40	55	30	40	4
East Lamoine	1	89	20	10	......	22	10	4	19	4
Bass Harbor	1	92	13	8	2	16	25	9	14	5
Brooklin	1	155	26	24	......	28	35	13	23	6
West Deer Isle	1	57	6	....	......	15	10	10	10	6
Green's Landing	3	185	20	30	......	36	65	5	24	5
Total	45	4,315	780	516	2	755	848	525	702	187

NOTE.—This table does not include the weir fishermen, nearly all of whom fish their own weirs and sell their catch to the canneries most conveniently located and paying the highest prices. In 1886 they numbered 1,110, of which 650 were Canadians and 460 Americans.

Table of apparatus and capital employed in the American sardine industry in 1886.

Location of canneries.	Number of canneries in 1886.	Average weekly pay-roll.	Value of shore property.	Collecting boats.		Additional cash capital.	Total capital invested.
				Number.	Value.		
Robbinston	2	$400	$13,500	3	$1,450	$1,400	$16,350
North Perry	1	600	5,000	2	10,000	20,000	35,000
Eastport	19	720	*196,100	68	39,640	477,800	723,540
Pembroke	2	200	5,000	5	1,150	15,000	21,150
North Lubec	4	412	13,500	8	1,550	15,700	30,750
Lubec	4	612	25,000	11	3,300	67,000	95,300
South Lubec	....	....	†4,000	....	....	....	4,000
Cutler	1	700	10,000	3	1,000	15,000	26,000
Jonesport	3	470	14,500	4	3,450	60,000	77,950
Millbridge	2	600	23,500	6	2,750	52,500	78,750
East Lamoine	1	700	6,500	3	500	10,000	17,000
Bass Harbor	1	650	20,000	4	6,600	22,000	48,600
Brooklin	1	1,200	20,000	2	5,200	50,000	75,200
West Deer Isle	1	250	5,000	3	450	5,000	10,450
Green's Landing	3	300	10,500	3	650	34,000	45,150
Total	45	7,814	372,100	125	77,690	845,400	1,305,190

*This includes the value ($10,500) of two factory buildings operated in 1885 but standing idle in 1886. One of them is located at St. Andrew's, New Brunswick, though both are owned by Eastport firms.

†This represents the value of a factory operated in 1885 but idle in 1886.

Table of products of the American sardine industry in 1885 *and* 1886.

Location of canneries.	No. of canneries in 1886.	Herring used in making sardines in 1886.	Quarter oils.		Half oils.		Three-quarter oils.		Quarter mustards.	
			1885.	1886.	1885.	1886.	1885.	1886.	1885.	1886.
		Hhds.	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*
Robbinston	2	744	12,529	11,639	550					
North Perry	1	350		4,000						
Eastport	19	17,714	*144,705	205,579	7,728	6,058		500	2,600	9,417
Pembroke	2	496	500	6,149						
North Lubec	4	693	11,000	6,795						140
Lubec	4	3,550	17,193	31,100						100
South Lubec			13,000							
Cutler	1	700		4,800						
Jonesport	3	3,180	6,300	25,737	225	300				3,559
Millbridge	2	2,226	3,500	15,691	900	203				
East Lamoine	1	1,000	1,165	8,806		403			116	501
Bass Harbor	1	1,000	2,800	4,200						
Brooklin	1	1,880	9,000	10,580	670	402			883	715
West Deer Isle	1	150		575						
Green's Landing	3	1,193		7,750						
Total	45	34,876	211,692	343,435	10,073	7,366		500	3,599	14,432

Location of canneries.	Half mustards.		Three-quarter mustards.		Three-quarter tomatoes.		Quarter spiced.		Half spiced.	
	1885.	1886.	1885.	1886.	1885.	1886.	1885.	1886.	1885.	1886.
	Cases.	*Cases.*	*Cases*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*	*Cases.*
Robbinston			3,200	980						
North Perry				500						
Eastport	2,500	2,323	35,363	35,205	1,412	260	150		3,223	
Pembroke			500	451						
North Lubec			942	713						
Lubec			7,176	9,575						
South Lubec			400							
Cutler				2,350						
Jonesport		3,500	1,500	3,327					500	
Millbridge			7,200	5,535						
East Lamoine			2,401	5,723						
Bass Harbor			5,600	8,400						
Brooklin			4,500	9,971	401					
West Deer Isle				600						
Green's Landing				3,160						
Total	2,500	5,823	68,782	86,490	1,813	260	150		3,723	

Location of canneries.	Three-quarter spiced.		"Brook trout" (herring).		Russian sardines.		Anchovies.	
	1885.	1886.	1885.	1886.	1885.	1886.	1885.	1886.
	Cases.	*Cases.*	*Cases.*	*Cases.*	*Bbls.*	*Bbls.*	*Bbls.*	*Bbls.*
Robbinston					204	45		
North Perry						15		
Eastport	4,400	5,269		162	2,550	3,513		
Pembroke					30	97		
North Lubec						2		
Lubec		800			315	654		
South Lubec								
Cutler								
Jonesport					100	590		
Millbridge					100	434		
East Lamoine		209	21	93		66		
Bass Harbor								
Brooklin	737	1,709	860		131	853		
West Deer Isle								
Green's Landing						370		400
Total	5,137	7,987	881	255	3,430	6,639		400

NOTE.—A case contains 100 quarter cans, 50 cans of the half and three-quarter sizes, and 24 cans of "Brook trout."

Table of products of the American sardine industry in 1885 and 1886—Continued.

Location of canneries.	Miscellaneous products.		Oil.		Pomace.		Total value of products, 1886.
	1885.	1886.	1885.	1886.	1885.	1886.	
			Gals.	*Gals.*	*Tons.*	*Tons.*	
Robbinston	120 case lobsters	5,500 boxes smoked herring; 400 cases lobsters.	4,995	800	109	47	$55,166.50
North Perry	....	....	....	600	....	70	25,000.00
Eastport	3,810 cases lobsters, 73,000 boxes smoked herring.	76,950 boxes smoked herring, 1,200 cases lobsters, 2,030 cases mackerel.	29,713	29,066	1,421	2,056	1,123,568.70
Pembroke	....	4,500 boxes smoked herring.	475	900	10	34	27,550.75
North Lubec	9,000 boxes smoked herring, 1,700 cases lobsters, 17,458 boxes bloaters.	19,600 boxes smoked herring, 2,000 boxes bloaters.	2,175	955	58	47	33,981.90
Lubec	38,315 boxes smoked herring.	65,000 boxes smoked herring.	4,885	4,145	316	136	175,725.00
South Lubec	8,000 boxes smoked herring.	2,500 boxes smoked herring.	360	....	15	....	300.00
Cutler	....	650 barrels pickled herring, 46,882 boxes smoked herring, 1,141 cases lobster, 143 cases 3-pound cans mackerel, cases 1-pound cans mackerel, 400 cases ¼-pound cans mackerel.	....	1,000	....	60	28,000.00
Jonesport	....	89 cases sardines in spices, odd sizes, 1,363 cases ¾-pound cans mackerel, 250 cases 1-pound cans mackerel.	....	2,900	....	325	189,908.00
Millbridge	2,000 boxes smoked herring, 4,200 cases ¾-pound cans mackerel, 41 cases clams, 57 cases broiled mackerel.	58 cases ¾-pound cans mackerel, 231 cases 1-pound cans mackerel.	1,170	900	105	116	96,286.00
East Lamoine	341 cases 1-pound cans fresh mackerel.	47 cases 3-pound cans sardines in mustard, 15 cases 3-pound cans sardines in spices.	....	....	35	100	66,699.61
Bass Harbor	4,000 cases 1-pound cans lobsters.	6,000 cases lobsters	....	....	40	90	100,000.00
Brooklin	1,100 cases 1-pound cans lobsters, 3,000 cases 1, 2, and 3-pound cans mackerel, 530 cases clams, 95 cases 2-pound cans sardines in tomato sauce, 500 cases ¼-pound cans sardines in tomato sauce, 100 cases 2-pound cans sardines in mustard, 1,612 cases 3-pound cans sardines in spices.	366 cases ¾-pound cans mackerel, 400 cases 2-pound cans mackerel, 1,588 cases lobsters.	1,380	1,000	75	100	118,481.00
West Deer Isle	400 cases lobsters, 75 cases clams.	350 cases mackerel	....	....	....	10	6,748.00
Green's Landing	3,000 cases lobsters, 3,000 cases clams, 1,000 cases clam chowder, 1,500 cases mackerel.	450 cases mackerel	....	....	....	100	45,450.00
Total	....	....	45,653	42,266	2,184	3,381	2,072,865.46

---

[*] The products given for Eastport in 1885 includes those of two factories which were in operation in 1885 but not in 1886. One of these was located at St. Andrews, New Brunswick, but was owned and managed by an Eastport firm.

[†] The factory at South Lubec was operated in 1885 but not in 1886.

INDEX.

- American Sardine Company ... 163
- Apparatus employed ... 188
- Baird, Spencer F ... 161
- Balkam, William A ... 163
- Bass Harbor, cannery at ... 188
- Bass Harbor Packing Company ... 163
- Blanchard & Sons, Hiram ... 163
- Boatmen's wages ... 181
- Boats for collecting fish ... 174
- Brewster, Charles H ... 163
- Brightman & Co., L. ... 164
- Brooklin, cannery at ... 188
- Brooklin Canning Company ... 163
- Brown & Co., E. W ... 163
- Burnham, George ... 162
- Canadian fish consumed ... 176
- Canadian Government, action of ... 185
- Canadian weirs, license for ... 169
- Can-makers' wages ... 182
- Canneries, location of ... 188
- Cans, method of making ... 178, 179
- Capen & McLain ... 163
- Capital employed ... 188
- Comstock & Co., Hiram C ... 163
- Cost of preparing sardines ... 180
- Custom-house regulations ... 185, 186
- Cutler, cannery at ... 188
- Cutters' wages ... 181
- David H. Wilson, steamer ... 164
- Deer Isle Packing Company ... 163
- Duty on fish, effect of ... 186, 187
- Duty on sardines ... 188
- Eagle Preserved Fish Company ... 163
- Earll, R. Edward ... 161, 177
- East Lamoine, cannery at ... 188
- Eastport, canneries at ... 188
- Eastport sardine industry ... 164, 183
- Economic questions ... 184
- Fish, American ... 176
  - drying of ... 177
  - method of collecting ... 175
  - price of ... 175
  - transferred to canneries ... 174
- Fishermen, wages of ... 174
- Flakers' wages ... 182
- Frontier Packing Company ... 163
- Green & Co., R. C ... 163, 171
- Green & Kelley ... 163
- Green's Landing, canneries at ... 188
- Green's Landing Packing Company ... 163
- Hallett Brothers ... 163
- Henderson, John ... 163
- Herring:
  - abundance of ... 164
  - as sardines ... 162
  - destroyed by squid ... 170
  - for smoking and bait ... 170
  - habitat of ... 164
  - movements of ... 167
  - price of ... 175
  - taken with seines ... 172
  - taking of ... 165
  - torching and seining for ... 171
  - transferred to canneries ... 174
- Holmes, E. A ... 163
- Holmes & Co., M. C ... 163
- International questions ... 184
- Jonesport, canneries at ... 188
- Jonesport Packing Company ... 163
- Kane, Peter M ... 163
- Laborers' wages ... 182
- Lamoine Packing Company ... 163
- Lampson & Co., A. W ... 163
- Lawrence & Co., E. P ... 163
- Lubec, canneries at ... 188
- Lubec Packing Company ... 163
- McCullough, Daniel ... 163
- McVickers, Mr ... 172
- Markets ... 182
- Millbridge, canneries at ... 188
- Millbridge Packing Company ... 163
- Morey, S. B ... 163
- New England Sardine Company ... 163
- North Lubec, canneries at ... 188
- North Perry, cannery at ... 188
- O'Grady & Co., George ... 163
- Oil used in canning ... 178
- Packers' wages ... 182
- Parker & Pike ... 163
- Pembroke, canneries at ... 188
- Pembroke Packing Company ... 163
- Prices of fish ... 174
- Products of sardine industry ... 189, 190
- Quoddy Packing Company ... 163
- Reynolds & Avery ... 163
- Robbinston, canneries at ... 188
- Russian sardines, manufacture of ... 179
- Saint Croix Packing Company ... 163
- Sardine canneries:
  - capacity of ... 177

Page.
Sardine canneries—Continued.
  description of ... 176
  foreign trade ... 183
  location of ... 163, 164
Sardine herring:
  fishing season for ... 170
  measure of ... 174
Sardine industry:
  apparatus employed in ... 188
  capital employed in ... 188
  competition in ... 164, 174, 175
  history of ... 162
  increase in ... 163
  needs of ... 186
  persons employed in ... 188
  products of ... 189, 190
  statistics of ... 188
Sardine manufacture:
  experiments in ... 162
  names of manufacturers ... 163
Sardines:
  cooking of ... 178
  cost of preparing ... 180
  labels on ... 179
  methods of drying ... 177
  methods of preparation ... 177
  packing of ... 178
  price of ... 187
  Russian, manufacture of ... 179
  shipments of ... 182
Sawyer, H. F ... 163
Schroeder, Mr ... 167
Seamers' wages ... 182
Seine-fishing:
  catch by ... 172

Page.
Seine-fishing—Continued.
  disadvantages of ... 173
  men employed in ... 172
  prohibited ... 173
Seining for herring ... 172
Seining grounds, location of ... 172
Sellmann, Henry ... 162
Shipments of sardines ... 182
Smith, Hugh M ... 162
Snell, Merwin-Marie ... 161
Squid enemies to herring ... 170
Statistics of the industry ... 188
Stimpson & Young ... 163
Torch fishing ... 171
Underwood & Co., William ... 163
Wages of fishermen ... 174
  paid ... 181
Warren & Co., T ... 163
Washington, treaty of ... 184
Weir-boats ... 169
Weir-fisheries ... 165, 169
Weir-fishing, men employed in ... 168
  profits of ... 167
Weirs:
  catch of ... 167
  construction of ... 165, 166
  cost of ... 165
  damaged by ice ... 169
  location of ... 165
  manner of fishing ... 168
Wentworth & Co., A. H ... 163
West Branch Sardine Company ... 163
West Deer Isle, cannery at ... 188
Wolff & Reesing ... 163
Young, J. D ... 163

ERRATA.

Page 162, line 41, for "he," read "the." Page 164, line 1, for "Bightman," read "Brightman." Page 173, line 19, for "work," read "at work." Page 173, line 37, for "sardine-boat," read "market-boat." Page 176, line 3, for "carried," read "carried by sail-boats." Page 176, line 13, for "Canadia," read "Canadian." Page 176, line 28, for "Quaddy," read "Quoddy."

47.—THE STRIPED BASS OR ROCKFISH INDUSTRY OF ROANOKE ISLAND, NORTH CAROLINA, AND VICINITY.

BY S. G. WORTH,

Field superintendent.

Large quantities of striped bass are caught here, the industry being perhaps the largest anywhere to be found. I arrived on the island, at Manteo, the last week in December, when operations had been terminated, but upon inquiry of many persons, nearly all inhabitants being fishermen, I obtained a fair outline of the industry from its origin. The fishery is of recent establishment, having been put on foot in the year 1872. Little else is captured other than the rockfish, and nearly the entire product finds its way in ice to the Northern cities, via canal to Norfolk. The establishment and continuance of the pursuit accounts fully for the decrease or disappearance of the species at the fisheries higher up on the Albemarle Sound, as the Roanoke Island fishermen remove thousands of fish from the waters each fall season upon their entrance into the fresh-water sounds from the sea in search of food. About Roanoke Island, in the spring time, the shad fishery produces about 500,000 shad, valued at $110,000, and the fall "rocking" is considered by the fishermen to be equal to two-thirds of the value of the shad catch, or about that.

At Roanoke Island, and immediately around there in the Pamlico, Croatan, and Albemarle Sounds, from September 5 to December 25, there are operated 1 seine, 9 purse seines, 25 drag-nets, and 17 pound-nets or traps in capturing rockfish.

In the Albemarle Sound, near Alligator River (mouth), 21 pounds or traps; at Durant's Island, 5 pounds; in Alligator River, 13 pounds; and near Edenton Bay and Rockyhock Creek, 7 pounds. In Pasquotank River, 3 pounds; a total of 9 purse seines, 1 haul seine, 25 drag-nets, and 66 pounds or traps. Besides, there is considerable twine used in gill-nets to capture this species in Alligator River in fall and winter.

Netting employed.

Device.	No.	Fathoms.	Size of mesh (stretched).
Seine	1	800	
Purse-seines	9	900	Wings, 2¼ inches; bunt, 2 inches; depth of net, 300 meshes, or 7 to 10 fathoms.
Drag-nets	25	2,500	Mesh as in purse-seines.
Pounds or traps	66	6,600	Leads, 2¼ inches; pocket or trap, 2 inches.
Crops gill-nets (estimated)	5	750	6-inch mesh.
Total	106	11,550	

Boats employed.

Devices or nets.	No.	Boats.	No.
Haul-seine	1	Flats	2
Purse-seines	9	Sloops and schooners of 9 to 10 tons	9
		Small boats	18
Drag-nets	25	......do	25
Gill-nets	5	......do	5
Pound-nets	66	......do	22
Total	106		81

Value of outfit (as found).

1 haul-seine, boats and net complete (estimated)	$1,300.00
9 purse-seines, boats and net complete	10,800.00
25 drag-nets, boats and net complete	3,125.00
66 pound-nets, boats and net complete	13,000.00
5 crops gill-nets, boats and net complete (estimated)	875.00
Total	29,100.00

Persons employed.

	Men.
1 seine (estimated)	12
9 purse-seines	63
25 drag-nets	75
66 pounds or traps	50
5 crops gill-nets	12
Total	212

The chief part of the catch is taken in Croatan and lower Albemarle Sound, near Roanoke Island.

Ownership and fishing localities.

Device.	No.	Owner's name.	Locality.
Haul-seine	1	Mrs. L. Brinkley	Croatan Sound.
Purse-nets	1	T. M. Guard, Elizabeth City	(?)
Do	1	John Pinner, Elizabeth City	(?)
Do	1	John H. Midgett	Croatan Sound.
Do	1	T. M. Guard, Jr	Do.
Do	1	T. M. Walker	Do.
Do	1	W. B. Alexander	Alligator River.
Do	1	Geo. C. Daniels	Roanoke Sound.
Do	1	T. W. Daniels & Bro	Do.
Do	1	Spencer Daniels	Do.
Drag-nets	25		Vicinity Roanoke Island.
Pound-nets	17		Do.
Do	3	Ike Hettrick	In and near Alligator River.
Do	2	Hook Swain	Near Alligator River.
Do	4	Meet Smith	Do.
Do	2	Joe M. Pledger	Do.
Do	3	Wash. Bland	Do.
Do	4	S. S. Barnett & Sons	Do.
Do	3	Harrison Hayman	Do.
Do	5	Spruill & Woodley	At Durant's Island.
Do	5		At Frying Pan, Alligator River.
Do	8		At Newport News, Alligator River.
Do	7		In and near Edenton Bay.
Do	3		Pasquotank River.

ANNUAL CATCH.

During 1886, which was an average year, the catch at Roanoke Island was about as follows (in boxes of 200 pounds each):

1 haul-seine (estimated)	40
1 purse-net (George C. Daniels)	170
8 (other) purse-nets	600
25 drag-nets	[*]500
17 pound-nets	[†]510
Total	1,820

Or 364,000 pounds fish of all kinds.[‡]

Of the 1,820 boxes, 1,398 were rock, equal to 279,600 pounds, or 186,400 fish (of 1½ pounds weight each). Above Roanoke Island, and to be added, there were caught (estimated) as follows (in boxes of 200 pounds each):

49 pound-nets caught	490
5 stands gill-nets caught	200
Total	690

Of the 690 boxes, about 500 were rockfish, representing 100,000 pounds, or 68,000 fish.

The aggregate catch, therefore, based upon careful estimates, was 253,000 fish of 380,000 pounds weight.

CONDITION OF FISHERY.

In 1887 this fishery experienced a failure, the second failure since its establishment fifteen years before. The catch of 1887 about Roanoke Island was as follows (17 pounds between Roanoke Marshes and Roanoke Island, Old Dominion Wharf):

Caught by—	Pounds.	Boxes.
L. Cudwith	2	40
Forbes	3	25
Baum Bros	5	200
Somers C. Baum	2	50
Meekins	2	10
Davis Bros	1	10
R. S. Midgett	2	15
Total	17	350

One-half of these, or 175 boxes, were rock, and represent 23,333 fish, or 35,000 pounds, a decrease, compared with 1886, of 33 per cent. The catch of the purse and drag nets was very much poorer than that of the traps, and their catch being about equivalent to or less than board of men, the failure was very decided. One purse-net crew were far behind on board, and several firms shipped less than one-tenth the usual number of boxes. In 1886 George C. Daniels's purse-net yielded 34,000 pounds of fish, and in 1887 only 1,000 pounds.

---

[*] Two-thirds rockfish. [†] One-half rockfish.

[‡] Other kinds are food-fish; no guano works.

CAUSE OF FAILURE OF SEASON.

Though nearly all engaged lost their work for two months, and some money besides, every one, without exception, declared that there was no decrease in the run of fish, but a mere absence of "top bait" or young menhaden. The rock were feeding on "bottom bait," croakers, spots, young trout, etc., contrary to custom, and fishermen were unable to locate the schools so as to lay nets around them. In 1886, and other regular seasons, a dozen schools could often be sighted at one time, but the "slicks" or "signs" in 1887 were very infrequent and were generally deceptive, as they came from the bottom and appeared on the surface at long distances from the true source. In support of argument they stated that whenever it was calm or smooth enough to fish outside, near the ocean inlets, drag-nets caught an abundance, proving that there was no decrease in the species, but for inside work there was no guide, gulls and slicks being alike unreliable. In the spring season of 1887 a very large number were caught in the Hettrick pounds near Pear Tree point (above), and in May of the same season L. R. Tillet caught outside the inlets, with 80 fathoms of seine, at one haul, 4,000 pounds of 5 to 60 pounds weight each.

I could find no fishermen, among 20 consulted, who would admit that the species was at all on the decrease, all maintaining with a uniformity that strengthened their statements that the fish were just as plenty now as fifteen years ago, notwithstanding that the fishery reached present proportions within three years of its establishment, and has been steadily kept up to its present volume. Two, Messrs. Godwin and Etheridge, claimed that it would be a benefit if they could exhaust the stock, as the shad and herring fishery would be greatly enhanced. They and all others admitted that the rock fish frequented these waters for the sole purpose of eating the millions of small fry which were collecting in the lower sounds prior to leaving fresh water for the sea. They spoke of the rock as a "popping" or "snapping" species.

There is no doubt that a smaller number of the species is caught by the shad and herring fishermen in the spring time on the Albemarle and other waters above, as my 1887 shad statistical report shows. There seems really to be no diminution but rather a transfer of the catch from the upper area in the spring months to the lower in the fall months. The only objectionable feature in the transfer, in a commercial way, so far as could be learned in a rather brief examination, is the lower price realized for the fish caught in autumn. If any considerable number of unmarketable fish are caught at Roanoke Island and destroyed or wasted, I was unable to learn anything of it by numerous inquiries. Great improvement is going on among the people of Roanoke Island, and this industry has doubtless been a contributor of some importance. They have excellent shipping facilities, and ice is used liberally in preparing the standard (200-pound boxes) for market, in New York, Philadelphia, and Baltimore.

Mr. S. C. Baum, who is regarded as one of their best citizens and fishermen, informed me that he had many times weighed the fish purposely to ascertain the average weight, and that he had found them to average, all through, 1½ pounds. While he was speaking of the great bulk taken below, I am satisfied, from my recollection, that with those taken in the few scattering pounds near Edenton, the size was not so great as a pound and a half, but nearer a pound each. I am very sorry that I could not reach Roanoke Island till the end of December, for the fishing was then over and I had not the advantage of personal examination. Inquiry led to the belief that the catch about Roanoke Island is not affected with lice on the gills, as it is about Edenton, where *all* specimens seen by me were parasitic. In quality I was told that the rock were poor in September, improved in October, and fat in November. I was surprised to learn from Mr. W. B. Alexander of the success of the gilling business in Alligator River. He informed me that Mr. J. H. Cooper had just taken $600 worth in that stream, the smaller specimens weighing 50 pounds each. The nets are 12-inch mesh and are made fast to stakes, and catch throughout the winter months in water 6 to 8 feet deep, 25 miles up the stream. This species of gilling had been in vogue for three years.

The results of my photographing on Roanoke Island, as incidental to my trip, were very satisfactory, and comprised the "building of boats there" (very superior small craft), and also represented a very fine seine steam-flat; the property of Mrs. Brinkley.

WASHINGTON, D. C., *June* 1888.

48.—INFORMATION BEARING UPON THE ARTIFICIAL PROPAGATION OF MULLET.

By W. de C. RAVENEL.

The following is the result of a trip to investigate some of the mullet fisheries of North Carolina and Florida, made in accordance with directions from the Commissioner. The instructions were to obtain all available information concerning these fisheries, particularly such as would be of practical value in entering upon the artificial propagation of this species with the view to arresting the rapid decline in the value and production of the South coast fisheries.

The inquiry was particularly addressed to determining the following points:

(1) The localities where the fish are now found in greatest abundance.

(2) The habits of the species as to seasons of migration from salt to brackish or fresh water and their return.

(3) The spawning season; as to its varying with the latitude, its extreme limits, and its height.

(4) Spawning places—whether in salt, brackish, or fresh water; kind of eggs—whether floating, free and heavy, or adherent; the period of incubation at a given temperature; and all other facts that will serve to disclose the methods and apparatus necessary for artificial work.

(5) Quantities of eggs that can be obtained from the regular fisheries, and whether it will be necessary to have recourse to apparatus of our own to secure a supply.

On November 21, 1887, I left Washington for Morehead City, N. C., which is situated at the junction of Bogue Sound and Newport River, about 2 miles from Beaufort, and where most of the fishermen have their headquarters. On my arrival the mullet season there was over, only a few small ones being taken for local consumption. From the largest dealers there I learned that the mullet season commences there about June 1 and continues until November 15, during which time there are three distinct runs: small mullet, 4 or 5 inches long, from June to August 30; fat mullet, from September 1 to October 10; and roe mullet, from October 10 to November 15.

The roe mullet appear in large schools, coming from fresh and brackish water and going out to sea, where they are believed to spawn and then go on down the coast, as they are never seen returning, and spent fish are not caught. The fish shipped from this point are caught entirely in salt water, from Bogue Sound out to Cape Lookout and all along the banks down the coast, about 500 gill-nets and 15 or 20 haul-seines being used during the past season. Large mullet seem to be getting more scarce every year, though more fish were actually shipped than for several years, the increase in the amount being due to the immense number of small fish now caught. The total shipment from Morehead City and Beaufort was 900,000 pounds—400,000 fresh and 500,000 salted. One dealer told me that on several occasions he had gotten 4,000 fine fish in the Trent River (fresh water) during the month of January.

Having arrived in Jacksonville, Fla., on the 25th and visited the markets and seen the mullet then being caught (all of which were full-roed), and having interviewed the largest fish-dealers there, I went down the St. John's River to New Berlin and Mayport, the headquarters of most of the men who fish in the Lower St. John's. During my stay at these places I had an opportunity of overhauling all the mullet caught below Jacksonville, and found most of them full-roed, and one or two "galam boties" (as the spent mullet are called by the natives); but did not succeed in getting any ripe fish.

Mr. David Kemp, of New Berlin, who has fished for the past twenty years from Lake George to the mouth of the St. John's, says that mullet have decreased very rapidly in the past ten years, and that unless measures are taken to protect them the fishery will soon be broken up.

According to him, the run of fat mullet, which is the roe-mullet not fully developed, commences about October 15 and continues until November 15, when, as roe-mullet, they come down the river and go out to sea to spawn, and return in a short time as "galam boties." He attributes the decrease mainly to the use of 2¼-inch mesh nets in summer and early fall, when quantities of very small fish are taken. Mr. I. V. Balsom, who has fished all his life in the St. John's and along the eastern coast of the State, said that Saint Augustine and Musquito Inlet are the natural spawning-grounds of the mullet, and that he has seen the eggs running from the fish in his cast-net. He is probably the most successful mullet-fisherman on the St. John's, and his catch for this season is 4,500, whereas in 1877 his catch was 13,000, having taken 2,260 at one drift of a 200-fathom gill net.

At Mayport the falling off is even more apparent, only 16,000 having been shipped from that point this season.

About 40 gill-nets and 1 sweep-seine were fished on the Lower St. John's this season, and their entire catch was not over 100,000 large mullet.

As little or no fishing was being done at Saint Augustine I proceeded, after one day, to Mosquito Inlet, arriving there on the 7th. All of the mullet caught during my stay there had spawned, a very large school having gone out at the inlet the week before. Any day small schools of "galam boties" could be seen coming in and working their way up the rivers to the lagoons. Mr. Bartolle Pacetti, who has lived about one mile from the inlet on the Halifax for thirty-five years, and who is the most observant fisherman I met in the State, says there is no doubt about mullet going outside to spawn. The roe-mullet begin to come down from the lagoons and rivers about November 15, and continue until December 31. Forming in large schools, they often swim about near the inlet for several days, and then go out, returning in a few days, sometimes in two tides, nearly every one spent. During January the shores near the inlet are lined with very small mullet about 1 inch or less in length, which gradually form in larger and larger schools, and as the season advances work up the rivers and lagoons, where they remain until they mature. Mr. Pacetti has frequently examined the roe-mullet caught just before going out, and always found it firm, though he has seen the eggs about the size of a mustard-seed run out into the cast nets. Mullet stay all the year inside, only going out to spawn, and they return in much smaller schools; which fact probably accounts for their not being seen to return along the North Carolina coast and in the St. John's River. Owing to the lack of shipping facilities up to this time, fishing has not been conducted on an extensive scale; but as fish can now be shipped by rail from New Smyrna to any point, there is no reason why this industry should not develop rapidly. About 100,000 mullet were shipped this season, besides other fish.

Leaving New Smyrna on the 13th, I arrived at Punta Gorda on the following day. Punta Gorda is situated near the head of Charlotte Harbor Bay, at the mouth of Pease Creek, about 25 miles from the Gulf. The fish-houses are all built on the South Florida Railway wharf, about 2 miles from the town, where most of the fishermen make their headquarters. The fishing-camps are scattered from Punta Gorda to Boca Grande pass. Mullet have only been caught in considerable quantities in the upper part of the bay since the opening of the South Florida Railroad to this point, about two years ago, though two large ranches for supplying the Havana market with salt mullet have been in operation at the passes for eight or ten years. The dealers here have shipped this season about 1,700,000 pounds, or 800,000 mullet, and could have shipped about double as much if the shipping facilities had been better. The dealers, as a rule, own their boats, nets, etc., and pay the men from 1 to 1¼ cents apiece for the fish. When I arrived they were catching mullet in large quantities, full-roed and nearly ripe, and they told me that the fish would begin to spawn about the 20th. Men who have fished and bought fish all along the coast say that mullet are much more abundant here than anywhere else on the Gulf coast. The supply at Cedar Keys and Tampa, which have been up to this time the chief shipping points, having given out, they are now supplied from Suwanee River and Sarasota Bay, which necessitates carrying the fish 30 or 40 miles before they are packed for shipment. Most of the men here believe that mullet go to fresh or brackish water to spawn; and one man said that he had often seen schools of spent fish coming down out of fresh water, and that fishermen always located their camps at the mouth of fresh-water rivers in preference to salt, knowing that the fish had to go there to spawn. All of my observations and the testimony of every man on the Atlantic coast opposed this theory; and after staying there three weeks and visiting the camps and ranches, I could find nothing to substantiate it. On the 20th I left Punta Gorda on a sloop, and after visiting the fishing camps went on to the ranches.

I first visited the Spanish ranch on Cayo Costa Island, near Boca Grande pass. The force consisted of 28 men to work the seine and cure the fish and 6 men to run the smack, all under Captain Tweno, a Spaniard. All of the fish caught are salted, and the roe dried in the sun for shipment to Cuba, where the price is about 4½ cents per pound for the fish and 10 cents for the roes.

The day I arrived at the Spanish ranch I saw several hundred "galam boties" caught, and every day afterwards large numbers were brought into the ranches; but they were considered very inferior for salting purposes.

The captain, who has fished here for eight years, informed me that "galam boties" were always caught either coming in at the pass or working up the bay, but never going out, though he has seen them outside in 15 fathoms of water. The fishing season here lasts from September 15 to January 15. There seems to be no diminution in the supply of mullet, 10 scow-loads having been landed at one haul this season, each scow holding about 4,000 mullet. The seine used is 125 fathoms long, 6 fathoms deep, 2-inch mesh, and about 200,000 mullet have been taken up to date this season.

I next visited an American ranch on Gasparilla Island, near pass of same name, owned by Capt. John Peacon, of Key West, who has fished here for thirteen years, shipping salted mullet to the Cuban markets, which he regards as more profitable than selling them fresh. During my stay there I saw from 8,000 to 10,000 mullet split, salted, and packed, and had an excellent opportunity of examining them, the fish being often brought in alive. I found none ripe, but one or two seemed nearly so, and I tried to impregnate the eggs, but after keeping them thirty-six hours and seeing no change I concluded they were not sufficiently matured.

Captain Peacon thinks that mullet are as plentiful as ever, but he objects to the fishermen continuing to gather here from other points. On calm days he has seen the Gulf coast literally lined with small mullet about the size of a pin, and in his opinion there is no doubt that the fish spawn outside; that is, in salt water. His catch this season, from September, with a force of 30 men, is about 250,000; seine used, 150 fathoms long, 6 fathoms deep, and 2-inch mesh.

On the 3d of January I left for Cedar Keys, where I learned that the season for mullet was nearly over, and that fish had become so scarce in the immediate vicinity that most of the dealers contemplated removing to the head of Sarasota Bay.

Mr. Dopson, of the Suwanee Gulf Company, informed me that ten years ago a haul of 30,000 mullet was made at their wharf, but now they had to send 20 and 30 miles to procure mullet even of an inferior size. Dr. McElvane, another dealer who was about to move, stated that he was anxious for some steps to be taken to protect and increase the supply of mullet. He was one of the few on the Gulf coast who was of the opinion that mullet spawned in salt water.

The results of this investigation are stated as follows:

(1) Mullet are most abundant on the Atlantic coast at Morehead City, N. C.; in the St. John's River, Mosquito Inlet, and Indian River, Fla.; on the Gulf coast, in Charlotte Harbor Bay, Sarasota Bay, and the Suwanee River. They have decreased greatly on the North Carolina coast, in the St. John's River, and at Tampa and Cedar Keys, and these are the localities where fishing has been done on the most extensive scale up to this time; and the decrease is to be attributed mainly to the use of small-meshed nets, by means of which the fish are destroyed before they come to maturity.

(2) Mullet migrate from fresh and brackish to salt water during the months of October and November in North Carolina, and in November, December, and January along the coast of Florida, for the purpose of spawning, and return to brackish water immediately thereafter.

(3) Mullet spawn in salt water on a falling temperature, spawning later as you go south; commencing in the St. John's, Mosquito Inlet, and at Cedar Keys, about December 1, and continuing until the 31st; at Charlotte Harbor about December 20, and continuing until January 20.

(4) Having failed to obtain any ripe fish it is impossible to say what style of apparatus would be required for the propagation of mullet, or whether their eggs sink or float.

(5) Charlotte Harbor is unquestionably the point where mullet are most abundant, and the best adapted for fish-cultural work, two large ranches being worked at the main entrance to the bay, and sixty or seventy gill-nets fished in salt and brackish water from the passes to Punta Gorda. The vessels engaged in this work could lay in either salt or brackish water as the work required.

WASHINGTON, D. C., *February* 21, 1888.

49.—NOTE ON THE OCCURRENCE OF THE OPAH, LAMPRIS GUTTATUS, ON THE GRAND BANKS.

By DAVID S. JORDAN.

I have received from Hon. Everett Smith, of Portland, Me., the description and figure of a "sunfish" recently brought to the Portland market, and reported to have been taken off the "Grand Banks." Mr. Smith gives the following description:

"Length, 60 inches; vertical depth, 25 inches; skin smooth, without scales; mouth, small; opercles, very large; color, steel blue, iridescent, silvery on lower parts, variegated over whole body by oblong, whitish spots of one inch and less in length; fins, yellow."

From this description and an outline drawing kindly furnished by Mr. Smith, it is evident that the species is the Opah, *Lampris guttatus*, Retz., a rare pelagic fish, once before recorded from the Newfoundland Banks.

BLOOMINGTON, IND., *October* 26, 1888.

50.—SELF-REPRODUCING FOOD FOR YOUNG FISH.

By FRANK H. MASON, CONSUL.

Every person who has been interested in the artificial propagation of fish, and particularly trout and the several other species belonging to the genus *Salmo*, knows what care and labor are necessary to carry the young fry through the period immediately following the absorption of the umbilical sac, and to bring them to such a stage of maturity that they can be safely turned loose in open ponds or streams to shift for themselves. The mere hatching of the eggs involves no difficulty, and, under fair conditions, is ordinarily so successful as to make the propagation of fish in almost any quantity an apparently easy matter. But with the commencement of artificial nutrition the serious part of the task begins, and it is usually a small percentage of the swarms which are hatched that reach the maturity of yearlings, at which period the dangers of infancy are past. During the intervening months it has been customary to feed the young alewives on curdled milk, coagulated blood, finely hashed meat and liver, grated yolk of eggs, macerated brains of animals, etc., the preparation of which, and the frequent feeding of the dainty little creatures, involves constant and more or less costly labor. Moreover, none of these forms of nutriment have been found entirely satisfactory, for the reason that they are all distinctly artificial and different from the living, organic food which nature provides for those species of fish during their tender, infantile period. The difficulty of providing proper nutriment results often in turning out the young fry into open water too early, when the temperature of the stream or pond is so much below that of the tanks in which they have been hatched that they perish by thousands from chill and inanition, without making an effort to find natural food in their new element. Accordingly the problem has been to devise a natural, self-reproducing food, so easy and certain in preparation that it may be cheaply and abundantly provided, and thus facilitate the maintenance of the alewives during the first ten or twelve months of their existence, by the end of which time they should be so strong and active that a large majority may be relied upon to survive the struggle for life in larger waters.

The result seems to have been fully attained by a discovery made several years ago by Mr. F. Lugrin, of Geneva, and practiced since 1884 in the piscicultural establishment at Gremaz, in the department of Ain, in eastern France. As this process has been examined and approved by eminent experts, sent specially for the purpose by piscicultural societies of England and other countries, it is thought that some account of it may be of interest to the large and rapidly growing class of fish-culturists in the United States.

Mr. Lugrin was for many years a practical fisherman on the Lake of Geneva. He noted the steady diminution of the more important species of fish in the lake, and sought to ascertain the cause. He gradually reached the conclusion that the germ of the trouble lay in the growing scarcity of minute crustacea and the larvæ which are the natural food of the trout and other fish, especially during their first months of nutrition.

After elaborate experiments, he hit upon a system by which *Daphnia*, *Cyclops*, fresh-water shrimps (*Gammarus pulex*), etc., could be bred in countless myriads at a merely nominal cost. The hatching and rearing of a generation of these minute creatures is the work of from twelve to fifteen days, and as the process may be repeated—or rather repeats itself—again and again in the same water, the problem would seem to be solved.

Whoever has watched from a place of concealment the trout feeding in an American stream has admired the adroitness with which they work down stream, raising with their noses the up-stream edge of flat stones until the current, catching underneath, aids the clever little forager to turn over the stone and expose the minute larvæ and crustacea on which he so voraciously feeds. It is the purpose of the process now under consideration to raise by artificial means these same species of organisms, and in such quantities that the young fry may not only be abundantly fed in tanks or small inclosed ponds, but ample supplies provided for enriching larger streams and ponds where, for some reason, the natural supply may be insufficient.

The apparatus is simple, and visitors properly introduced have no difficulty in seeing the entire establishment at Gremaz, which occupies a gently sloping piece of ground, about 6 acres in extent and watered by three springs, which yield collectively about 500 gallons of water per minute. The tanks are rectangular excavations, about 120 feet long by 12 in width, with a depth of 5 feet. The ground being of a gravelly character it was necessary to line the walls and bottom of some of the tanks with cement in order to retain the water, but in close clayey earth this would be needless, and the natural dirt bottom, if not too muddy, would be preferable to cement. The tanks have the same general level, and are divided by sliding gates of wire gauze sufficiently fine to prevent the passage of the fry. Thus far all is simple and obvious. The process of Mr. Lugrin, which has been patented in several countries, consists in spreading upon the bottom of these tanks a material impregnated with the elements necessary to produce spontaneously a limitless number of *Daphnia*, *Cyclops*, *Limnæa*, as well as fresh-water shrimps, and the larvæ of various *Ephemera* which form the natural aliment of trout and other *Salmonidæ* at all stages of their growth. Once constructed and impregnated with this producing material—which is of trifling cost—these tanks go on with their work automatically and indefinitely.

The water, from 2 to 3 feet in depth, being left undisturbed two or three weeks, is found peopled with swarming myriads of minute organisms of the species above named. Twenty thousand trout a year old, or 3,000 two years old—which last should average about one-half pound in weight—are considered sufficient for a pasture of that size, and the avidity with which they rush to occupy and ravage their new feeding-ground is a delight to the pisciculturist. If the propagation has been ordinarily abundant these 20,000 young fry or 3,000 yearlings will subsist royally in a tank of the size indicated for an entire month. They will eat on an average 20 to 25 pounds of food per day, or 600 to 800 pounds per month. Careful experiment has demonstrated that each tank at Gremaz will produce 650 to 900 pounds of *Crevettes* (fresh-water shrimp), to say nothing of the myriads of *Daphnia*, *Cyclops*, and other species produced in the same water during the same time. When, at the close of the month, the tank has become depleted, the gate is opened and the fish driven like a flock of sheep to a new and similar pasture. The first tank, being closed and left in quiet, immediately begins the process of reproduction, and at the end of two or three weeks is swarming again with the varied minute organic life which far surpasses in value, as food for fish, anything that has been yet devised by man. Thus the simple, inexpensive process goes on from year to year, the fish always healthy and vigorous and larger at two years old than those artificially fed are at the age of three years. Yearlings bred in this way are strong, and capable of making their way in any open stream or pond supplied with food and suitable for their existence. One thousand of such yearlings have been found more effective in stocking a depleted trout stream than fifty thousand young fry turned in, as has been so often done heretofore, in order to get rid of them at the tender age when artificial feeding first becomes not only necessary but difficult and troublesome. For these tender nurslings all open waters, particularly when inhabited by older trout or other voracious species, are beset with a thousand dangers which the vigorous yearling is able to escape.

It is evident from all this that the system practiced at Gremaz is equally applicable to the industrial raising of trout and other fish for market, and to the restocking of streams and ponds for purposes of sport. In the first case, it is only necessary to provide a series of tanks or small ponds from one to another of which the fish can be changed monthly, as hereinbefore described, until they reach a marketable size; and it is to be remarked that trout raised by this method have the natural firmness and flavor of wild fish, and not the flabby, degenerate character of those which have been fed on liver, offal, and other unnatural, degrading food. Once prepared, a tank or pond is permanently productive. However voracious the young fish may be, they leave the bottom of the water still peopled with myriads of parent organisms which reproduce so rapidly that, before the end of a month, the placid water becomes clouded with swarming millions of their progeny. The fecal matter dropped by the fish during their month of occupancy is sufficient to maintain the fertility of the bottom, and thus the system, once established, becomes automatic and self-sustaining.

A single attendant can have the care of a large establishment, his only duty being to drive the fish periodically from one feeding ground to another and close the gate behind them, as a farmer changes his flocks from one pasture to another.

It remains to be explained that while the *Daphnia*, *Nais*, *Cyclops*, and other extremely delicate species can be profusely grown only in still water, the fresh-water shrimp (*Gammarus pulex*) grows abundantly in living streams. At Gremaz, rivulets are provided which flow from the springs into the tanks and carry away the overflow. These rivulets, the bottoms of which have been impregnated by the Lugrin system, are filled with cresses and other water plants and produce the minute shrimps in such abundance that they are gathered daily in panfuls by a few sweeps of a gauze scoop-net and fed to the fish in the swarming tanks. This part of the process is easily applicable to natural streams where a sufficiency of food does not already exist.

As to the applicability of this system to American pisciculture, there is apparently no room for doubt or question. The same natural conditions which exist at Gremaz can be found in nearly, if not quite, every State in the Union. The same food which is produced there may be used in growing nearly every species of fish which is artificially reared in the United States. American brook trout, the rainbow trout and California salmon thrive admirably in the tanks at Gremaz.

To conclude with the verdict of Prof. Francis Day, who, in October last, came specially from England to investigate and report upon the system which has been so successfully established there:

"When I remark that a tank, 35 meters long by 3 broad, and 40 centimeters deep, and capable of containing 20,000 young trout, can be fully stocked with food in fifteen days, so as to be able to sustain the residents for one month without any additional supply, I can not help thinking that Mr. Lugrin has solved a difficult problem, and that his mode of cultivating the natural food of fishes will prove a great and lasting benefit to fish culturists."

MARSEILLES, *February* 25, 1888.

51.—THE PISCICULTURAL ESTABLISHMENT AT GREMAZ (AIN), FRANCE.*

By C. RAVERET-WATTEL.

About four years ago I had the honor to call the attention of the National Acclimatization Society to a piscicultural establishment which had been founded in the Department of Ain, at Gremaz, in the township of Thoiry, for raising trout as an industry. I pointed out the special interest which, in my opinion, this establishment seemed to possess, as its founders, Messrs. Lugrin and du Roveray, have succeeded in solving a problem of considerable importance from an industrial point of view, viz, to furnish the young fish with food solely composed of living prey proportioned to its size.

It was exceedingly important to find some natural food for the young fish, and since Messrs. Lugrin and du Roveray have demonstrated the great usefulness of the *Daphniæ* in this respect, several pisciculturists have looked for some practical means of providing a sufficient quantity of these small crustaceans. Attempts to multiply them rapidly in ditches filled with slightly muddy water succeeded; but this method presents serious inconveniences. According to Mr. Chabot-Karlen, the *Daphniæ* gathered in these ditches are extremely tender; the least agitation kills vast quantities; the greatest precautions are therefore required to gather them; and, moreover, these small crustaceans impregnated with muddy water must be carefully washed in clear water, in order not to become actual poison for the young fish.

The method employed in the Gremaz establishment is by far preferable. As I have stated in my previous report ("*Bulletin de la Société d'Acclimatation*," November, 1882), the *Daphniæ* are raised in the very basins which are destined for the fish. When a basin has been sufficiently prepared for the development of these small crustaceans, they are allowed about a month's time to increase; then the fish are put in the basin, where they at once find abundant and substantial food. Whilst this stock of food is being consumed, other provision is made. A neighboring basin is prepared like the first; *i. e.*, it is abundantly stocked with *Daphnia*. After another month has passed, the fish—which by that time have consumed nearly all the food in the first basin—are put in the second, where they again find ample food. A month later they are again put in the first basin, which meanwhile has again become stocked with *Daphnia*, and so on. This method is extremely simple and convenient. Messrs. Lugrin and du Roveray, however, do not confine their efforts to raising *Daphnia*, but they likewise

---

***Nouveaux renseignements sur l'établissement de pisciculture de Gremaz (Ain)*. From *Bulletin mensuel de la Société nationale d'Acclimatation de France*, fourth series, Vol. IV, No. 5, May, 1887. Translated from the French by HERMAN JACOBSON.

use larvæ of insects, and especially small fresh-water shrimps, which, as we shall see, form an exceedingly abundant article of food, particularly in winter.

When, in the year 1882, I visited the Gremaz establishment for the first time, I was positively astounded at the quantity of *Daphnia* in the basins, forming dense clouds in the water. But that was in the beginning of October, after a long period of fine and warm weather, during which these small crustaceans had had the chance to multiply at an enormous rate. I was, therefore, curious to return to the establishment to see how matters stood during the bad season. From this point of view, no better moment could have been selected for my visit. Without being exceptionally severe, the winter in this region has been somewhat prolonged. Shortly before my arrival the thermometer had fallen to 13 degrees below zero. On the day of my visit it was still 3 degrees below zero, and the basins, which had a feeble current of water, were covered with ice. The ice had been broken in several places, and we could, consequently, examine the water underneath. I must say that the *Daphniæ* appeared to me to be just as numerous as during the fine season, which, however, is easily explained in water as cold as that in these basins; but when we dipped out some of the water from the bottom of the basins, with a sort of canvas purse-net, we brought up incredible quantities of larvæ of the *Chironoma* and still more larvæ of the *Ephemera*. The whole bottom of the basins seemed to be one mass of animal life. At every haul we got a big dish full of these larvæ, which are an exceedingly valuable article of food for the young fish. The water which is artificially prepared for the *Daphnia* is, therefore, likewise well suited for the development of other small aquatic animals which can be utilized as food for young fish.

But Messrs. Lugrin and du Roveray are not contented with this source of food. Alongside of the basins there are small rivulets, artificially made, for raising small fresh-water shrimps (*Gammarus pulex*), which, by a method similar to the one employed for the *Daphnia*, are caused to multiply in enormous numbers. In these rivulets, filled with water-cresses and other aquatic plants, the little shrimps, which form so important a part of the food of the trout, are raised. Every day the daily ration allowed to the fish is gathered with nets in a few minutes; and it is a curious spectacle to see this food given to the fish. The young trout come from all directions in dense masses. They vigorously attack the little shrimps, and do not allow a single one to get to the bottom of the water. No matter how large the quantity of shrimps it vanishes in a few moments.

The young fish of Messrs. Lugrin and du Roveray thrive admirably on this diet. Three basins, each having a surface of about 120 meters, contained about 70,000 fish of this year's raising, grouped according to size, and all in excellent condition. From their well-developed stomach and their finely-rounded forms, it will be seen that these young fish have not only never suffered hunger, but that they have always had abundant food of excellent quality. This kind of food, composed exclusively of insects and small crustaceans, is exceedingly suitable for these young fish on account of the large quantity of phosphate of lime which it contains;[1] and this circumstance explains the rapid growth, and the exceptionally fine and vigorous condition of the young trout raised at Gremaz.

It may be well to add that the profitable use made of the small shrimp-streams will soon give way to a still simpler method of utilizing these small crustaceans, by proceeding in exactly the same manner with *Daphnia*, *i. e.*, the fish will be successively, or rather alternately, passed from one basin to the other, to consume a stock of food previously prepared for them. By experiments Mr. Lugrin has ascertained that a basin 35 meters (114.8 feet) long, and 3 meters (9.84 feet) broad, with an average depth of water of 40 centimeters (1.3 foot),[2] may contain 20,000 young fish from eight to twelve months old, or 3,000 two-year old trout, having an average weight of 250 grams ($\frac{11}{20}$ or a little more than one-half pound). These 20,000 young fish, or 3,000 trout, consume about 10 kilograms (about 22 pounds) of small shrimps per day,[3] or 300 kilograms (about 660 pounds) per month. It has been proved by experiment that a basin having the above-mentioned dimensions can produce 300 to 350 kilograms (660 to 770 pounds) of shrimps, without at all interfering with the *Daphnia*, *Nais*, *Limnæa*, insect larvæ, etc., which simultaneously develop in the same basin. Under these conditions food will never be lacking. It is sufficient to have two basins for each lot of fish, so as to transfer them each month from one basin to the other.

The system employed at Gremaz is, therefore, exceedingly profitable from an industrial point of view. But it is specially destined to render excellent service in stocking rivers with fish. Doing away with all difficulty as regards food, it makes it possible and even economical to keep the young fish, intended for stocking rivers, for a certain time in the basins free from all danger. Those young fish which, owing to the lack of suitable or sufficiently cheap food, had to be set out in the rivers at a very early age, before they had had time to gain strength, may now be safely left in the basins till they have grown stronger. When several months old the young fish is already vigorous; it knows how to flee from danger; it is, therefore, better able than younger fish to escape numerous accidents and causes of destruction. Rivers may, therefore, be stocked with much greater prospect of success; and it may safely be asserted that 3,000 or 4,000 young fish, ten to twelve months old, are infinitely more valuable for stocking a river than 10,000 or 15,000 very young fish, which, not being strong enough to bear the change from the basin to the river, often perish in large numbers when placed in the river, where they become an easy prey to older fish living in the same waters.

---

[1] It is well known that the substance which forms the skeleton of insects and crustaceans is, with many species, largely composed of calcareous matter, and is exceedingly rich in phosphate of lime. It is probable that to this circumstance must be attributed the results of Stoddart's experiments: "Three lots of young trout were placed under absolutely identical conditions; one lot was fed on fish, the second on *Annelida* and mollusks, and the third exclusively on insects. All the fish of the last-mentioned lot developed much quicker than those of the others." In England insects are also considered excellent food for young trout.

[2] These are the dimensions adopted for the new basins of the Gremaz establishment, the projected enlargement of which contemplates the creation of 136 such basins.

[3] 10 kilograms (22 pounds), dry measure, of small shrimps represent about 7 litres (about 1¾ pints) of liquid measure.

This opinion is at this day shared by the vast majority of pisciculturists in Great Britain. Nearly everywhere in England and Scotland it is considered that the best young trout for stocking rivers are those which are about a year old, and which for this reason are called "yearlings."[1]

These young fish are strong enough to seek their food, and consequently to avoid the principal cause of mortality in young fish, viz, inanition; they can easily be transported, and will bear a change of water without difficulty. These young fish cost, it is true, considerably more than others, but as the final expense is much less, and the result is much more prompt and certain, there is an absolute advantage in using them for stocking rivers.

There is only one point in the system which leaves something to be desired: If one operates on that large scale which is required for stocking an entire river, it involves considerable labor to assure the feeding of the young fish with artificial food. As the animal is, so to speak, *made* during its early age, and as during this period its assimilating organs acquire their strength and their power of absorption, a young fish which is insufficiently fed not only grows very slowly, but will never become a fine fish. It has been ascertained long since that if, of young fish of one and the same hatching, one portion is immediately placed in the river, whilst the other portion is kept in basins and fed with extreme care, the first will, after a short while, be twice as large as the second, because they have food which is better adapted to their needs; only, the losses among those which have been kept in basins will not be as large (unless the circumstances are particularly unfavorable), whilst the ranks of those which have been placed in the river have often been thinned to such an extent as to leave hardly any. They have fallen a prey to water-rats, perch, pike, and even to older trout.

Thanks to the system of raising employed by Messrs. Lugrin and du

---

[1] This term is really applied to fish which in many cases are from 10 to 14 months old. Practically speaking, the age of a fish is counted from the date when it begins to eat, and not from the date when it was born. Thus, a trout of 1887 is a fish which commenced to eat in February or March, 1887, although it may possibly have been born about the end of the year 1886, and not in the beginning of 1887.

Roveray, all these inconveniences disappear; kept in basins, protected against all danger, the young fish, abundantly fed on live food, develop as well if not better than under natural conditions, without involving any serious expense for their food; and when the suitable moment has arrived, they can easily be transferred to the waters for which they are intended, without running the risk of losing many.

It is therefore greatly to be desired that the administration should abandon the use of very young fish for stocking rivers (as they are nearly all doomed soon after they have been placed in the river) and give the preference to fish ten or twelve months old, which, as is stated above, have yielded the most satisfactory results in England and Scotland.

Messrs. Lugrin and du Roveray, convinced of the advantages of their system, propose, at their own expense, to stock a water-course which, being subjected to special supervision, will enable them to make an absolutely convincing experiment.

52.—REPORT ON THE PISCICULTURAL ESTABLISHMENT OF PIEDRA, ARAGON, SPAIN.*

By F. MUNTADAS.

All persons who devote themselves to practical pisciculture will remember the change of opinion which took place some years ago, owing to the weakness of many persons whose experiments proved failures. Our Acclimatization Society, however, has never allowed itself to be influenced by the "piscicultural malaria;" it has always stood firm and preserved its faith in the future; it well understood that the discovery of two fishermen of the Vosges Mountains could not become merely a subject of curiosity or pleasure. It is true that a large number of amateurs have taken a wrong road, but many others have followed the right road, and have made marked progress in the successful method of raising salmon.

From the moment that the question of raising large quantities of young fry and young trout was agitated, it became necessary to pay attention to many different circumstances, and not to forget the cost of raising fish; for the problem is to derive some profit from the new industry, and, according to Mr. Larbaletrier's expression, "to make money by pisciculture, and not pisciculture by money."

All the methods of artificial feeding are expensive and, what is worse, do not entirely answer the purpose; it therefore became necessary to find and use natural elements. In short, it became necessary to give the young trout what it needed.

[Rapport sur l'établissement de pisciculture de Piedra, Aragon (Espagne).] From *Bulletin mensuel de la Société nationale d'Acclimatation de France*, 4th series, Vol. IV, No. 8, August, 1887. Translated from the French by HERMAN JACOBSON.

I had read in the Treatise on Pisciculture, by our late colaborer, Mr. Carbonnier, that in places where the fresh-water shrimp (*Gammarus pulex*) is produced the raising of salmonoids was easy. I ransacked my waters for these precious crustaceans, and, having found them in considerable quantities in the sources and along the course of the Devil Rock Brook (*Peña del Diablo*), I went to work and had my first rearing basin constructed. It was a complete success, and I had the honor to report it to the Acclimatization Society, which rewarded me by one of its medals. My young fish swallowed the little shrimps with the greatest delight, and seemed to care very little for the coagulated blood which was given to them in accordance with the instructions of the majority of treatises on pisciculture.

Ever since my first season I have used nothing but small shrimps for feeding my young trout, which grew amazingly fast. This method was followed during the first eight months. Later they found in the large basins (besides myriads of small shrimps) tadpoles, gudgeons, and craw-fish, of which they are very fond, especially during the shedding period of these crustaceans. In a special compartment I tried chopped meat (mutton, rabbit, etc.); but when I found that the carnivorous trout did not develop any quicker than the ichthyophagous ones I fed all of them on fish and crustaceans.

The enemies of the young fish (water-snakes, water-ousels, water-rats, etc.) committed great ravages in my open-air basins; and, with a view to prevent these ravages, I had a basin constructed of cut stones, 10 meters (32.8 feet) long, 1 meter (3.28 feet) broad, and 50 centimeters (1.64 feet) deep. The whole was covered by a small house with windows protected by gratings and a very close net-work of wire both down and up the stream.

The experiment had a twofold interest, viz: On the one hand to keep away the enemies of the young fish, and on the other to prove the success of my method of feeding the young fish after the umbilical sac had been absorbed. This twofold object was attained, and I am enabled to state that not only was the loss smaller, but the young fish kept in this basin developed more rapidly than the others. When, in September, I transferred the young trout to more extensive waters, those which had come from the stone basin gained on the others in every respect.

In places where there is clear and cool water containing some lime, and where the fresh-water shrimp reproduces naturally, I have discovered the best method of raising salmonoids. It therefore gave me great pleasure to read that at the Gremaz establishment Messrs. Lugrin and du Roveray had succeeded in solving the problem of raising young fish by the same means which I had employed here, and which I had described in the report which I had the honor to submit to the Acclimatization Society in July, 1872.

The closer we follow nature, the more certain we are of success. It may give an artificial pleasure to see a few young fish in a hatching-basin and to watch the absorption of the umbilical bag; some of them may even be kept for some time on more or less expensive artificial food; but when it comes to pisciculture on a large scale, when the object in view is to stock large sheets of water, these means are insufficient.

I well remember a long conversation I had with Carbonnier. He told me in a firm and convincing manner that, as I had on my property at Piedra a water-course, which was always cool and limpid, and which had a considerable fall, I should abandon the Coste and all similar apparatus, and use the Jacobi box, placing it to half its height in the water (natural method), and, as I had large quantities of small shrimps, to give my fish small shrimps (natural food), and not think of any other food. I followed his advice, and my season of 1871–'72 was so remarkable that the Acclimatization Society rewarded me with the large gold medal at the public session of April, 1873.

From 1872 to 1874 I lived in France—two years lost to my pisciculture. On my return I had to begin over again; but as I felt sure of my method, I again set to work, and my establishment soon reached the high state of perfection which it had occupied prior to my visit to France.

The stone basin (mentioned already in my report for July, 1872) proved a great success. It produces on an average 1,200 trout every year, and the open-air basins contain young fish by the thousand, more or less, according to the zeal and the efforts of the various fishermen in whose charge they are. The food is always the same during the first two months, small shrimps assorted, furnished two or three times a day; later, small shrimps such as are gathered with small purse-net attached to the end of a stick, at the sources of brooks, and in the large basins; for these crustaceans multiply wherever the water of the Devil Rock Brook is found.

Although trout placed in rivers consume an enormous quantity of these small shrimps, a great many remain attached to cresses and other aquatic plants. The positively prodigious quantity of small shrimps in the lake, the sources of the brook, and the large basins has so far not allowed me to think of raising these crustaceans in the rivers, and saves the trouble of transferring the trout alternately from an exhausted river to one still containing many of these small shrimps.

Our young fish remain in one place from March till September, and they are fed two or three times a day, as their needs seem to require it; and it is a curious spectacle to see them in dense masses pursuing their living prey. The quantity of small shrimps given to the fish two or three times daily weighs 5 kilograms (about 11 pounds). Having carefully counted the number of shrimps contained in 5 grams (about one-sixth ounce), and found this number to be 672, the total quantity of shrimps fed to the fish in a single day is not less than 672,000, or 4,704,000 per week.

The importance of the fact that this food is furnished free of cost will easily be understood; and the circumstance that it is quickly distributed all over the basin renders it certain that all the young fish will get their share of food. One-third of the food is served to the trout in the stone-basin, where the trout of the season of 1886 may now be seen. Such is the result of confining the fish for sixteen months.

No sun, no vegetation, no hiding-places, no quiet retreats along the banks; and in spite of these conditions, which a theorist would consider disadvantageous, these trout measure 18 to 22 centimeters (7⅛ to 8⅝ inches) in length. And to what is this owing? Simply to the abundance of food and the impossibility of finding hiding-places. The crustaceans are devoured as soon as they are put into the basin, as there is no place where they could hide. It would be hard to find yearling wild trout as strong and fat as those which have been confined in the basins ever since the umbilical bag has been consumed.

Since the month of October last, the piscicultural establishment of Piedra has been rented by the Government. At this time there may be seen in the raising-basin thousands of this year's trout which have already reached an average length of 7 centimeters (2¾ inches). These basins swarm with crustaceans, and nevertheless the three daily rations are never omitted. If one asks the fishermen as to the harvest of small shrimps, they invariably answer: "The more we take, the more there seem to be."

If the Government will construct inclosed basins on the existing model, it might try to acclimatize exotic species without fear of hybridization, which is an important point.

Mr. Raveret-Wattel points out the way to restock the rivers, not only with young fish, but also with trout 8, 10, and 14 months old, as is done in Scotland with those called "yearlings." I entirely agree with Mr. Raveret-Wattel and the Scotch pisciculturists. If there is war, soldiers should be sent out, not babies; it is not the number which assures success, but the age and valor of the soldiers. Leaving this figure, which, however, shows the reason for employing "yearlings," I venture to assert that if this system gains ground, the old system of stocking rivers should also be abandoned at Piedra, and the new system introduced. There will be no lack of food for the "yearlings," for in digging out new ponds fed by the Devil Rock Brook it will be found that after two months they will be filled with cresses and other aquatic plants; and underneath these plants large numbers of small shrimps will be found, as has been the case in all the ponds which have been dug, where many millions of these small crustaceans are caught every year.

In some places where the water freezes, the reproduction of the crustaceans is possibly suspended for some time. I can not state this with absolute certainty, for I have not had occasion to make the necessary observations; but it seems to me that ice would not favor reproduction. In the lake and in the Devil Rock Brook the temperature, even during the severest winter weather, never falls below 50°. This is really a spring temperature, and I have with my own eyes seen small shrimps reproducing in winter as well as during the other seasons of the year. I doubt whether there is any other place as highly favored by nature for raising salmonoids, and also cyprinoids (tench, barbel), and crawfish.

Where the small shrimp is not found and the water contains particles of lime, attempts should be made to introduce it and favor its reproduction.

53.—AMERICAN SILVER PERCH, OR CALICO BASS.

By GILBERT DUCLOS.*

M. Emile Bertrand has recently sent to the Fish Culture Establishment of the Zoological Garden of Acclimatization a number of American silver perch, or calico bass (*Pomoxys sparoides*), born in a pond belonging to him in the vicinity of Versailles.

The reproduction of this species in 1888 was very considerable, for not only the three-year-old fishes, but even those born in 1887 have yielded an enormous number of eggs from which young calico bass were developed. The three-year-old fish living in M. Bertrand's pond are now about 7¾ inches long and 2¾ inches deep. The first spawning fish were imported directly from America. M. Bertrand had 25 of them. On account of the fatigue of the voyage only two males and a number of females survived.

The spawning of the first year, 1887, yielded M. Bertrand more than 500 fry, some of which were given to various members of the Acclimatization Society; others were sold. The flesh of the calico bass strongly resembles that of our European perch (*Perca fluviatilis*). After the spawning of 1888 M. Bertrand estimated that he had many thousands of calico bass. At the time of spawning, more than a hundred nests have been observed which have been placed in water about 8 inches deep. Evidently this species loves heat. The spawning places most sought after for the nests were the stone steps descending into the pond. The water being shallow the steps receive the sun's rays, retaining the heat to the advantage of the fishes.

The adult fish does not fear the cold. M. Bertrand, desirous to learn whether the calico bass would thrive in impure waters, placed a number of the young in a little pool which received waters full of impurities, and of which the temperature rose to above 77 degrees Fahrenheit. In spite of these unfavorable conditions the calico bass have prospered and have increased rapidly. Individuals which were ⅛ of an inch long in April, when they were placed in this pool, measured 3¼ inches in the following August.

---

*La Perche Argentée d'Amérique ou Calico Bass. From Revue des Sciences Naturelles Appliquées No. 1, January 5, 1889, p. 12. Translated by Dr. T. H. Bean.

The calico bass will be an excellent addition to our waters, for not only is it very hardy but also very fertile; besides, its rapid growth and the good quality of its flesh make it an altogether desirable species. It will be very serviceable, also, as food for the *Salmonidæ*, on account of its remarkable fecundity. Its introduction into waters already stocked will cause no inconvenience, for, although it is predaceous, the calico bass has a mouth so small that it can seize only little animals, worms, small crustaceans, etc.

M. Bertrand, desirous of propagating this very interesting species, placed again this year at the disposition of the members of the National Acclimatization Society some of the young. These young fishes will be delivered about the month of April.

54.—A HYBRID BETWEEN THE LAKE TROUT AND BROOK TROUT.

By TARLETON H. BEAN.

The Pennsylvania Fish Commission has been experimenting for some years, at the Corry Station, with hybrids between the lake trout, *Salvelinus namaycush*, and the brook trout, *Salvelinus fontinalis*. A very brief account of the experiments is to be found in the report of that commission for 1886. Some fine specimens of these artificially produced hybrids have been received by the U. S. Fish Commission. A large one measuring about 20 inches in length is apparently a male as the lower jaw has a small cartilaginous tip. The end of the maxilla extends behind the eye a distance nearly equal to the length of the snout. The scales are larger than in the brook trout and about equal in size to those of the lake trout. The caudal is deeply forked, about as deeply as that of the lake trout. In shape the hybrid is similar to the lake trout, as, also in the general pattern of coloration; but the very numerous spots on the sides are somewhat smaller and a pale lemon in color instead of whitish. The spots below the middle line of the body have a center of orange. The pectorals, ventrals, anal, and the lower lobe of the caudal have a broad white edge. The ventrals and anal are a pale vermilion orange. The outer half of the upper surface of the pectorals is dusky. There is a narrow black line limiting the white of the ventrals and a similar trace bounds the white of the anal. The ground color of the sides is greenish-olive. The sides of the head have numerous spots of lemon-yellow, some of them larger than the largest of those on the sides. The lips are yellowish flesh colored; the eye is golden, with a dusky border; the top of the head and back have some scattered vermiculations like those of the brook trout, but much less developed and not so plentiful. The caudal and dorsals are spotted with lemon-yellow, like the sides.

A smaller one, supposed to be a male, has the back slightly elevated as in old male brook trout, but its caudal is forked and it has the large scales and peculiar coloration of the hybrid.

54.—RESULTS OF INVESTIGATIONS BY THE SCHOONER GRAMPUS ON THE SOUTHERN MACKEREL GROUNDS IN THE SPRING OF 1887.

By D. E. COLLINS, T. H. BEAN, and RICHARD RATHBUN.

The report on the investigations of the *Grampus* consists of three parts. The first is a narrative by Capt. D. E. Collins, who was temporarily in command of the vessel, stating the objects of the cruise, the equipment for fishing and research, the directions and distances sailed, the conditions of the air and water, the movements and catch of the fleet, the occurrence of mackerel and other important fishes and of the food of fishes, the success or failure of various kinds of bait and fishing apparatus. The *Grampus*, while cruising frequently with the mackerel fleet, was engaged also in independent observations at distances of from 20 to 75 miles in various directions, always returning to give the masters of fishing vessels any information which might be useful to them.

The second part, by Dr. T. H. Bean, is devoted mainly to notes on the fishes, cetaceans, and birds collected or observed during the voyage. The account consists principally of observations on the localities, movements, size, and food of the mackerel.

The third part, by Mr. Richard Rathbun, is a notice of the small surface organisms taken in the tow nets, and of the contents of mackerel stomachs. The general account of the character and distribution of the species was prepared by Mr. Rathbun; the identification of certain groups was furnished by several specialists; the amphipods, schizopods, cumaceæ, and decapods were referred to Prof. S. I. Smith; the medusæ to Mr. J. W. Fewkes; the mollusca to Mr. W. H. Dall; the insects to Mr. J. B. Smith.

REPORT UPON THE OPERATIONS OF THE UNITED STATES FISH COMMISSION SCHOONER GRAMPUS, FROM MARCH 15 TO JUNE 3, 1887. BY D. E. COLLINS.

The work of collecting fish and fish-eggs for the hatchery at Wood's Holl, Mass., closed on March 14, and the next day I received the following orders:

U. S. COMMISSION OF FISH AND FISHERIES,
Washington, D. C., March 13, 1887.

SIR: As soon as the *Grampus* can be got in readiness, you will, after taking on board at Wood's Holl any material needed for the cruise, proceed to sea. Your object will be to investigate the waters adjacent to the North Atlantic coast from Cape Hatteras to the Gulf of Maine, obtaining as much information as possible of the appearance and movements of the mackerel, menhaden, bluefish, or other sea fishes.

Very respectfully,

J. W. Collins.[*]

Capt. D. E. Collins,
U. S. Fish Commission Schooner Grampus, Gloucester, Mass.

From the date of receiving the above orders to the last of March, cold, stormy weather prevailed the greater part of the time, and hindered the preparations which had to be made for the cruise. Every opportunity was improved, however, to fit the vessel for sea. On March 24 the vessel was taken upon the marine railway at Gloucester and the outside of the hull was painted; the necessary painting inside, both below and above deck, had been done while she lay in the stream, previous to going upon the railway. All other necessary preparations—such as cleaning the masts, setting up the rigging, etc.—had been made whenever the condition of the weather permitted.

In compliance with the following instructions we sailed from Gloucester at 7 p. m. on March 30, and arrived at Wood's Holl 6.20 p. m. the next day:

U. S. Commission of Fish and Fisheries,
Washington, D. C., March 24, 1887.

Sir: I send you herewith a list of instructions for your guidance on the cruise, which you are about to make, for observing the habits and migrations of the mackerel, menhaden, and bluefish. So far as is practicable, you will attempt to carry out these instructions.

When you have completed your preparations at Gloucester for the cruise, you will proceed, as soon as the weather permits, to Wood's Holl, Mass., where you can land any material which you may have had on board during the winter for cod work, and that you think will not be needed for the coming cruise, or which might suffer from accident or deterioration if kept on board of the vessel. This material should be placed in storage in the room assigned to the vessel's use in the store-house, and such instructions as are necessary for its preservation can be left with Mr. Atkins at the station. If you think the wire hawser will not be needed, that could be put on shore also.

You will take on board for use on the trip—

(1) The mackerel and herring gill-nets belonging to the vessel.

(2) The bait-mill and other apparatus necessary for preparing and using "toll-bait."

(3) The stern boat.

(4) A supply of small towing-nets, which will be forwarded to you there. (In case these towing-nets are not at hand when you are ready to sail from Wood's Holl, it will scarcely be worth your while to wait for them.)

Your cruising-ground will be, generally, between Cape Hatteras and the Gulf of Maine, and should be mostly in proximity to the mackerel fleet, and you should continue with it as a rule, so that you may observe the work of the vessels and be able to record the appearance or non-appearance of fish in the locality where the fleet is working.

It will, however, be desirable for you to make extended observations, independent of the fleet, by running 25 to 75 miles, or even more, away from it to look for mackerel. In carrying out this clause of your instructions, you will, of course, have to be guided largely by circumstances and by your own judgment, since it is impossible to foretell the precise conditions under which you will have to work.

---

[*] Capt J. W. Collins was officially in command of the *Grampus*, but important duties made it necessary for him to be in Washington, and Capt. D. E. Collins was *placed in command pro tem.*

I suggest, however, in case you arrive on the fishing-ground north of Hatteras before any mackerel are seen by the fishing vessels, that you run some distance south or southeast of them and set gill-nets, if the weather permits. And it may be a good plan to set gill-nets where the mackerel vessels are, if they have not seen fish. By doing this you may get the first trace of the fish as they approach the coast.

Later, when the fleet gets to work, it will be well for you to leave it occasionally to run from 25 to 75 miles farther north, set nets at night, and also try "toll-bait" by day, to ascertain if the fish are moving faster than the fleet. Also, when the fleet is working inshore, you can run offshore 25 or even 75 miles, and try the same methods; or, if the fleet is offshore, run in.

By doing this and keeping a careful record of your work—such as the number and kinds of nets set, at what distance from the surface fish were most plentiful, the depth they were sunk, the occurrence of and apparent abundance of fish, the relative size of the mackerel as compared with those taken by the fleet, the number of trials made with toll-bait, location of same, results, etc.—you will add much valuable information to that we now have.

In this connection let me say that it will be desirable to give the fishermen any information that may result to their advantage; always, however, keeping a record of the fact, the name of the vessel, etc., to which this information is imparted, and, so far as it comes to your knowledge, a record of the result.

I think it will always be desirable, after making independent researches, to return to the fleet without too much delay, so as to keep open communication with the vessels and closely watch their movements.

Having opened communication with the fleet and learned something of its movements, what has been accomplished in your absence, etc., you can then make another cruise on your own account, if you see fit. You will always bear in mind that anything you can learn independent of the fishing vessels will be much more valuable than the information gained simply by watching their movements, although the latter is too important to be neglected.

It will not, of course, be necessary that trials be made very close together, and for results I think you will have to depend largely upon gill-nets. Trials with "toll-bait" made at distances of say 15 to 25 miles ought to be near enough, while gill-net experiments could be made at longer distances, say 25 to 75 miles apart, as circumstances seem to dictate.

In carrying on your work it is desirable that you should observe the following methods:

(1) Keep hourly records of the temperature during the day, and note the temperature every two hours at night, whenever practicable; also to continue to record, as you have been doing, the height of barometer and condition of the weather, state of the sea, kind of sky, etc.

(2) Note carefully the hours when mackerel appear and disappear, at night or otherwise, whether you may be in a fleet or at a distance from any fishing vessels, also the direction and rapidity of their migrations.

(3) When in a fleet, either in harbor or otherwise, obtain all possible information in regard to the appearance of mackerel, as observed by the fishermen. The date, locality, abundance of fish, number of vessels present at the time, and the catch (as nearly as it can be obtained) should be ascertained and recorded. It will also be desirable to write down the observations of the fishermen on the movements of the mackerel, and get from them statements of opinion as to the influence the weather and winds have on the movements or on the abundance of fish. These data and other facts can be kept in a book separate from the log-book.

(4) Note the appearance and approximate numbers of sea-birds, such as gulls, gannets, hagdons, jægers, etc.

(5) When in a fleet, note the numbers of vessels in sight and the area of ground they cover; that is, the distance from one side of the fleet to the other in an east and

west direction, and the same in a north and south direction; also note additions to the fleet during the day or departures from it.

(6) When making records of the presence of vessels, give your position as near as practicable (by dead reckoning or by observation) and state whether the larger part of the fleet is north, south, east, or west of you, and about how far off the most distant vessels are. This will define the positions of the fleet and show the ground it is working over.

(7) Note all movements of the fleet, whether working north or south, east or west, and the distance passed over each day or night.

(8) Note the number of seine hauls made by the vessels in the fleet, on each day you are with them, as far as practicable, and the percentage of "water hauls;" also the number of vessels getting fish. When you learn the name of the vessel note that also, and the quantity of fish taken.

(9) Note the number of vessels leaving the ground for market on any day, and their names if you know them.

(10) If you see differences in the size of the fish of various schools, on different days, always record the fact, and when practicable give the extreme and average lengths; also, when practicable, the relative numbers of males and females.

(11) If you see schools of fish "cart wheeling," note whether they are going against the sun (from right to left) or vice versa, and also what they appear to be feeding upon. Get specimens of "feed" when practicable.

(12) In setting gill-nets, it will be well, if the weather is favorable, to sink them at different depths; say, for instance, from the near surface (one or two fathoms below) to ten or fifteen fathoms deep. Note in what part of the nets fish are taken. Nets with different sized mesh should be put out so as to catch any fish that may be in the vicinity.

(13) In regard to the use of the towing-nets, it is considered important that towings should be made in the morning, at noon, and at evening, and the material contained in each collection should be properly preserved in separate bottles, and be labeled with the date, locality, and hour at which each was obtained. If this is carefully attended to, it will give us many data in regard to the food of the mackerel in the early part of the season. It may also be desirable to preserve the stomachs of a few mackerel and samples of ovaries, properly labeled, as you obtain them from day to day.

(14) The appearance and abundance of menhaden, bluefish, or other species should be noted, and specimens of any that are captured should be saved.

(15) As opportunity offers it will always be desirable to make trials with hand-lines from comparatively shallow water down to depths of 150 fathoms or more, and a record of the trials should be made with position, the depth of water, the number of lines used, kind of bait and time spent in fishing. It will also be desirable to preserve specimens of strange fish that are caught. The possibility of catching the tile fish, in depths from 75 to 200 fathoms, renders it especially important that trials with hand-lines should be made whenever opportunity offers.

(16) Should you have a good chance to kill porpoises, particularly a species remarkable for fine white spots, it will be proper to capture specimens. If you can not preserve the body cut off the head so that the skull may be saved. By consulting the figures of the Cetacea given in Mr. True's paper, published in Fish Commission Report for 1883, you may be able to identify tolerably well any animals of this kind you may have a chance to get. The common sea porpoise (*Delphinus delphis*) is not especially valuable. If you can capture a killer (*Orca*) it is very desirable to do so, and bring the specimen in the ship to Washington. Save sharks or their heads.

(17) It is important that the Commission should be in possession of all available knowledge looking toward the safety of life and property employed in the fisheries. Therefore, if a suitable opportunity occurs to test the drag you have on board, it will be proper for you to use it in accordance with instructions contained in a previous letter.

(18) When arriving in port, telegraph your arrival, and if you have specially valuable specimens on board, wire the facts. If you learn anything important relative to the movements or abundance of fish, give the facts to the Associated Press agent in any port you may visit.

(19) Report briefly by mail the result of your work.

Very respectfully,

J. W. COLLINS.

Capt. D. E. COLLINS,
U. S. Fish Commission schooner Grampus, Gloucester, Mass.

We remained at Wood's Holl until April 3 the weather in the meantime being stormy and boisterous. At 2.10 p. m., on the above date, we got under way to beat out of Vineyard Sound, but at 4.30 p. m. anchored at Tarpaulin Cove, where there were two schooners of the mackerel fleet, which were bound to the southern fishing grounds. On the morning of the 4th we left Tarpaulin Cove with a moderate southwesterly wind, which increased to a strong breeze in the latter part of the day, and caused a sharp, choppy sea. We therefore went into Newport Harbor, where we arrived before noon. At Newport there were nine or ten schooners of the mackerel fleet waiting a favorable opportunity to make their passage to the fishing grounds.

We sailed from Newport at 3.30 p. m. April 5, with a fresh northwesterly wind, which increased toward evening; outside of the harbor we met with a sharp sea coming from the southward, and, although we reefed the mainsail, the vessel's deck was filled with water most of the time during the night. At 1 p. m. on the following day we saw Barnegat light-house bearing west ½ north. The wind, in the mean time, had moderated considerably, and during the evening of the 6th all head sails were set. We ran along the coast, passing Five Fathom Bank light-ship at 8 p. m., being about 4 miles distant from it.

From this point we steered for the fishing grounds most generally resorted to by mackerel schooners at this season, and which are embraced within the parallels of north latitude 37 to 39 degrees, and between the meridians of west longitude 74 to 75° 25′. It will, however, be seen in subsequent paragraphs of this report that our researches were extended over a much larger area.

April 7 began with fine clear weather and moderate southwest wind, but at 9 a. m. the wind veered suddenly to north-northeast, although the weather continued clear and the sea smooth throughout the day.

In the morning two mackerel schooners were in sight steering to the southward. We ran in that direction also until 9.40 p. m., when the light sails were taken in, the head sails hauled to windward, and the vessel was hove to on the starboard tack.

During the day we saw several small flocks of sea-geese (Phalaropes) and occasionally a gannet.

There was a fresh north-northeast breeze and clear weather on the following day (April 8). At 6 a. m. a fleet of twenty-four sail of mackerel schooners was seen to the northwest of us. We filled away and stood in that direction. When near the center of the fleet we hove to and waited the approach of several of the vessels which were steering for us, and the captains of which were apparently anxious to communicate with us. A little later Capt. Eben Lewis, of the schooner *Edith M. Rowe*, came on board. Captain Lewis, who is well known as an energetic and skillful fisherman, and who was one of the first to sail for the fishing ground this spring, said he had been cruising for nearly two weeks, and had sailed over the entire region from the position in which we then were (lat. 37° 23′ N., long. 77° 45′ W.) southward to the latitude of Cape Hatteras and eastward to the Gulf Stream. In all this cruising he had not seen any mackerel nor heard of any vessel getting that species. About ten days previously he had caught a school of menhaden in his purse-seine nearly in the latitude of Body Island.

During the afternoon several other vessels of the fishing fleet spoke with us, and their captains reported substantially the same facts as given by Captain Lewis. None had seen any mackerel, nor had they heard of any being taken.

During the evening the fishing fleet all headed to the northward. We beat to windward also about 6 or 7 miles, and at 1.34 p. m. hove to and threw out "toll bait" for mackerel, but did not succeed in enticing any alongside. The trial was continued for forty-five minutes, when we got under way and ran southward a distance of 22 miles, where we again hove to, and made another attempt to "raise" fish with "toll bait," but with the same result as before. We also put out hand-lines for bottom fish in the same position, but caught nothing except spiny-backed dogfish. In the evening we hove to under the mainsail, all other sails being taken in, and set one herring and one mackerel gill-net; the former was set at the surface and the latter sunk to a depth of 2½ fathoms. The main-boom was guyed out so that the vessel made a square drift, and the nets were set at a "swing" to windward, the inner end of the warp being fastened at the mainmast. The position of the vessel was lat. 37° 04′ N., long. 74° 37′ W.

April 9 the weather was fine and clear, with a moderate easterly wind. The nets were hauled at 5 a. m.; six river herring, or alewives, were caught in the mackerel-net, and fifteen alewives and two mackerel were taken in the herring-net, the average length of the mackerel being 12 inches.*

There were seven mackerel schooners in sight in the morning, the majority of them steering to the eastward. Captain McFarland, of the schooner *Emma W. Brown*, spoke with us. I told him that we had taken two mackerel in our nets.

At 7.30 a. m. the small surface towing-net was put out and a considerable quantity of copepods (mackerel food) were taken in it. We then filled away and ran to the southward 15 miles. A man was stationed at the mast-head to keep a lookout for schools of mackerel, but no indications of the presence of fish were seen, except a few gannets that were occasionally seen passing the vessel. During the remainder of the day, with the exception of the time occupied in trials for fish, we cruised back and forth in various directions, as is the custom among fishing vessels when they have reached the locality where it is supposed mackerel may be met with. A man was at the mast-head constantly, and a sharp watch was kept throughout the day, but no fish were seen. At 6.20 p. m. a trial was made with "toll-bait" (lat. 36° 45′ N., long. 74° 53′ W.), but no results were obtained, although bait was thrown for more than an hour. We then steered to the eastward for a short distance, and at 7 p. m. hove to for the night.

---

* These mackerel were the first taken of the season.

On the 10th the wind was south-southwest in the morning, hauling to west-southwest in the latter part of the day; the weather clear and pleasant.

At 5.45 a. m. began to throw "toll-bait" for mackerel. Put over cod hand-lines baited with salted menhaden. No mackerel were caught; spiny-backed dogfish were in great abundance, and several of them were taken on the cod-lines. Our position was lat. 36° 29′ N., long. 74° 50′ W.

There were several fishing vessels in sight, but they were considerably scattered, some of them being 7 or 8 miles north of us, while others were as distant to the south, east, and west. Most of these vessels were standing to the southward. At 6.45 a. m. the captain of the schooner *Ella M. Adams*, of Gloucester, spoke with us and asked how far we had been to the southward.

The surface towing-net was put out this morning, but nothing was taken in it.

After completing the attempt to "raise" mackerel, we got under way and stood to the southward until we reached lat. 36° 04′ N., long. 74° 44′ W., where we hove to and made another trial for mackerel with "toll-bait," but without success.

A few sea-geese were seen during the forenoon, but nothing else which would indicate the presence of migratory fish.

At 11 a. m. got under way and set light sails, steering to the southward, with a look-out at the mast-head. At noon we met and spoke with the fishing steamer *Novelty*, Captain Joyce, who inquired if we had been far to the southward of the position we were then in. He had seen no mackerel himself, and had heard no news which might be considered favorable by the fishermen.

We stood to the southward nearly 45 miles without seeing any indications of schooling fish, and about dark hove to for the night. At that time ten or twelve sail of fishing vessels were near us, all of them lying to. During the evening, went on board of the schooner *Gertie Evelyn*, of Gloucester. Captain McIntire stated that he had cruised from the latitude of Five Fathom Bank, off Delaware Bay, to the edge of the Gulf Stream without seeing any mackerel.

Two of the vessels in the fleet put out their seine-boats during the evening, and it was evident that schools of surface-swimming fish had been seen; but I afterwards learned that no fish were taken.

The weather continued pleasant on the 11th, with a moderate to light breeze from west to northwest most of the day, dying away to a calm in the early part of the evening, and a light west-southwest breeze before midnight; weather pleasant and clear.

At 5.40 a. m. we hove to to try for mackerel with "toll-bait," our position being lat. 37° 22′ N., long. 74° 39′ W. At this time there were eight vessels in sight, and at 6.15 a. m. Captain McKinnon, of the schooner *Mayflower*, of Gloucester, spoke with us, and said he had seen plenty of fish in the water during the previous night. We caught no mackerel. Cod hand-lines were put out, but, with the exception of some spiny-backed dog-fish, nothing was taken. The trial for cod and mackerel lasted for nearly an hour. At 7.45 a. m. put out small surface towing-net and towed it for fifteen or twenty minutes, but took nothing in it. During the forenoon we steered from west to southwest by south, going along from 4 to 5 knots. At 10 a. m. four fishing vessels were seen standing to the westward.

A few phalaropes were seen during the forenoon. At 1.15 p. m. changed course to south ½ west and steered in that direction about 9 miles. At 2 p. m. saw six fishing vessels, all steering southward. At 3.25 p. m. hove to to try for mackerel with "toll-bait" in 23 fathoms of water (lat. 36° 58′ N., long. 74° 49′ W.). No mackerel were caught in a trial of about forty minutes. Got under way again at 4.02 p. m., heading to the eastward, and soon after saw fifteen fishing vessels to the eastward of us, manœuvring as if a school of fish were seen. At 5.25 p. m. we saw the seine-boat of the schooner *David A. Story* out looking for mackerel, but no fish were taken, as I learned when I went on board of that vessel.

At 6.15 p. m. took in all sails excepting the mainsail. Hove to, and at 6.30 set two gill-nets from vessel (lat. 36° 51′ N., long. 74° 34′ W. by dead reckoning).

At 5.25 a. m., April 12, we hauled the gill-nets and took in them one menhaden, but four other fish of that species which had been entangled in the twine fell out into the water and were lost before we could reach them.

Soon after hauling the nets the head-sails were hoisted and we stood to the northward on the starboard tack.

At 7.45 a. m. we spoke with the schooner *Nellie M. Davis*, of Gloucester, and Captain Malanson came on board of the *Grampus*. He stated that he had caught 100 barrels of menhaden in one set of his purse-seine during the previous night. The principal part of the fish, however, he threw away, saving only a few barrels which were salted for mackerel bait. Specimens of the fish were secured from him, and we preserved them in alcohol.

Shortly after separating from the *Nellie M. Davis* we spoke with the schooner *Robert J. Edwards*, of Gloucester. Her captain reported seeing menhaden abundant in the water during the previous night.

Throughout the day on the 12th we worked to windward, making a northerly course. The fishing vessels in sight were going in the same direction. At 6.30 p. m. all sail except the mainsail was taken in; we hove to on the starboard tack and set two gill-nets in 22 fathoms of water, our position being lat. 37° 32′ N., long. 74° 52′ W.

During the 13th the wind was easterly, increasing from a moderate breeze at daylight to a very fresh breeze in the evening.

At 5.20 a. m. hauled gill-nets. Only two butterfish were caught. After the nets were in we got under way and worked to the eastward. In the afternoon the wind had increased so much, being accompanied by a rough sea, that the mainsail and the head-sails were taken in and the vessel was hove to under the foresail.

April 14 the wind continued easterly, with a rough sea, during most of the day. At 10 a. m. we got under way and headed north-northeast close hauled by the wind. We continued in that direction throughout the day, having a man stationed aloft to look out for schools of fish. The prevailing easterly wind and rough sea were considered unfavorable conditions for fish to school at the surface.

We saw no fishing vessels until 4.30 p. m., when a schooner was seen to windward heading to the southward. Soon after four or five other fishing schooners were seen standing toward us from the southward.

We made no attempt to "raise" mackerel with "toll-bait" during the day, since there was little probability of attracting them to the surface with an easterly wind blowing. During the day we made an average course north-northeast (magnetic) and sailed a distance of 45 to 48 miles from the position left in the morning. At 7 p. m. the head-sails were hauled to windward and the vessel was hove to for the night.

From the 14th to the 18th of April the weather continued fine, and during that period we were almost constantly cruising between parallels 36° 20′ and 38° 50′ north latitude, and the meridians 73° 50′ to 75° 25′ west longitude.

On the night of the 17th, about 10 p. m. (lat. 36° 45′ N., long. 74° 50′ W.), two schools of fish were seen "firing" in the water, which we supposed to be mackerel. Gill-nets were set in the immediate vicinity of those schools, but no fish were taken in them. The failure to catch any specimens was probably due to the unusual amount of phosphorescence, which caused the nets to resemble sheets of fire. With the exception before named we saw no indications of schooling fish in our cruising during the period before mentioned.

We were in almost daily communication with vessels of the mackerel fleet between the 14th and 18th, and since the researches of these schooners extended over practically the whole area north of Hatteras, and the information obtained of them was to the effect that they had seen no mackerel, the inference was that fish of that species were far from abundant up to the date mentioned.

The remarkable scarcity, too, at this time, of whales, porpoises, sea birds, etc., which usually accompany schools of migratory surface-swimming fish, and the almost total absence of those forms of crustacea which constitute the principal food of the mackerel, had the effect to make the belief general among the captains of the fishing schooners that mackerel would be unusually late in their appearance off the coast, if, indeed, they came on in any considerable abundance.

April 18 began with an easterly wind, hauling southerly and freshening as the day advanced, with falling barometer and threatening weather.

At this date our supply of water was nearly exhausted, and the water still remaining in the tanks was so thick with iron rust that it was nearly unfit for use. I therefore determined to run into Hampton Roads for the purpose of filling the water tanks, since it was evident that I could do so without losing much time, as the weather would prevent investigation if the vessel remained at sea. We arrived at Hampton Roads at 6.20 p. m., and anchored.

On the 19th there was a fresh breeze from the northward, with rain squalls. During the day the fishing steamer *Novelty* and three of the mackerel schooners arrived at Hampton Roads for shelter. In the evening I went on board of the *Novelty* to learn as much as I could regarding the observations made by Captain Joyce, who has the reputation of being one of the most observant and successful captains engaged in the mackerel fishery. He told me that he had cruised from near Cape Hatteras northward to the Capes of the Delaware and eastward as far as the Gulf Stream. In all this cruising he had not taken any mackerel, and he expressed the opinion that they were yet south of the region which had been passed over by the fishing fleet; he also expressed some lack of confidence as to the appearance of fish on the coast in considerable abundance.

In compliance with instructions, we lay at Hampton Roads until the 22d of April; and on that day Dr. T. H. Bean, ichthyologist of the U. S. Fish Commission, joined the vessel to make the cruise with us, and we received on board some apparatus which had been brought from Washington by Capt. J. W. Collins, who made a temporary visit to the vessel.

There was considerable wind on the 22d, increasing from a gentle breeze in the morning to a fresh breeze, with rainy, threatening weather in the latter part of the day.

We got under way at 10.35 a. m., passed Cape Henry at 3 p. m., and headed out to sea, close hauled by the wind on the starboard tack. At midnight hauled down head sails and hove to for the night.

The weather was rainy and foggy on the 23d, with a very fresh southeast by east to south wind. It was too rough to do any fishing or make other observations. At 9 a. m. lowered mainsail and hove to on the starboard tack, under foresail and forestaysail.

A few sea-geese (Phalaropes) were seen toward evening, but, although the weather cleared at 5.10 p. m., no vessels were seen.

The wind continued fresh from south-southwest to north, with a rough sea, on the 24th, until the latter part of the day.

At 5 a. m. we saw a fleet of fishing vessels, most of them to the north of us, all lying to under foresails. At 5.45 a. m. the schooners *Augusta E. Herrick* and *Nellie M. Davis* spoke with us. From them we obtained the information that several fishing schooners had caught small fares of mackerel on the nights of the 20th, 21st, and 22d. As far as could be learned these fish were all small in size, and were marketed at New York. They were taken in lat. 37° 25′ N. and long. 74° 29′ W., approximately. The fish were caught in an area of several miles in extent, and the position given above would, perhaps, be about the center of the region where the mackerel were found.

The wind having moderated about noon we got under way at 12.45 p. m. and headed to the eastward. At 5.35 p. m. hove to, to "raise" mackerel with "toll-bait" (lat. 37° 34′ N., long. 74° 26′ W.), but caught nothing except dogfish. We then lowered and furled the foresail and set one mackerel and one herring gill-net, the former being sunk 3 fathoms below the surface, and the upper edge of the latter floating at the top of the water.

The nets were hauled at 5.35 a. m. on the 25th, but nothing was caught in them. We then got under way and put out the large towing net, which was towed for thirty minutes; a few young fish and a small quantity of copepods were taken in the net. We then stood to the eastward about 5 miles, when we tacked ship and headed to the northward.

At 3.15 p. m. I spoke with the fishing schooner *Howard Holbrook* (lat. 37° 48′ N., long. 74° 06′ W., approximately), and soon after I went on board of her. Her master, Captain Keene, said that on the night of the 10th of April he saw several schools of fish "firing" in the water, which he believed to be large mackerel, but as none of these fish were taken he could not be certain as to the species. These schools were seen in lat. 37° 50′ N., long. 73° 13′ W., approximately.

At 4.50 p. m. we hove to under foresail, the wind at that time blowing a fresh breeze, with threatening weather. During the night the wind blew a moderate to strong gale, and the sea was very rough. At 6.30 p. m. the foresail was double-reefed, and we lay to under that sail during the night.

There was a moderate gale, decreasing to a fresh breeze, during the forenoon of the 26th, with a sharp tumbling sea. At 12.50 p. m. we hoisted the head-sails and mainsail and headed NW. by N., close-hauled by the wind. At this hour there were eight schooners of the fishing fleet in sight. At 3 p. m. I went on board of the schooner *Common-*

wealth, of Gloucester, to obtain information. At 5.30 p. m. we hove to, to try for mackerel, and also put out codfish lines. Excepting a few spiny-backed dogfish nothing was taken.

I had intended to set gill-nets in the evening, but there was too much sea and wind to do so.

At 7 p. m. Capt. B. A. Williams, of the schooner *G. P. Whitman*, of Gloucester, came on board. I learned that he had left Gloucester on the 8th of April, but had not caught any mackerel up to date. He told me that he had recently cruised 90 miles east from the Capes of the Delaware, while three other vessels, in company with him at the time, continued the search for mackerel about 30 miles further in the same direction, but no fish were seen.

During the afternoon we saw several flocks of sea-geese, a few menhaden, and four or five sea-porpoises.

On the 27th the weather was much finer, with a south to southwest wind, generally moderate and variable in force.

At 5.40 a. m. the surface towing-net was put out for about an hour, and a small amount of material was taken in it.

At 7.10 a. m., got under way and steered to the northward. At 9.30 a. m. (lat. 37° 43′ N., long. 74° 15′ W.), hove to, to try for mackerel; also put out hand-lines for bottom fish in 36 fathoms of water. No mackerel were taken, and, although dogfish were numerous and proved exceedingly troublesome in stripping the hooks of bait before the gear reached the bottom, we caught six large hake, in the stomachs of which we found an abundance of fish food.

At 5.25 p. m. hove to, to try for mackerel, a few miles north of the previous position. No mackerel were taken. On the cod hand-lines we caught one pollock of about 20 pounds in weight, and found hake fairly abundant. From the stomachs of these fish there were taken sea-bass, alewives (or river herring), squid, mackerel, and sea-robins. The apparent abundance of food, and the character of the bottom, would suggest the possibility of this locality being a good feeding ground for the common hake.

During the afternoon the small towing-net was used and a considerable quantity of copepods were collected. Shortly after sunset the large towing-net was towed thirty-five minutes, and two young pollock and a few young hake were taken in it. At 7.45 p. m. hove to for the night.

During the most of the 28th the weather was pleasant, but in the afternoon the wind increased to a very fresh breeze accompanied by threatening weather.

At 8.15 a. m. there were thirty-one fishing vessels in sight, most of them being to the northward of us, and the majority "jogging." We spoke with the *Ossipee*, of Gloucester, and her captain reported leaving Delaware Breakwater on April 27, in company with sixty sail of the fishing fleet. We "tried" for mackerel with "toll-bait" (lat. 37° 40′ N., long. 74° 13′ W.), but without success. We then steered to the southwest until 1.40 p. m., when we began to shorten sail, and at 2.45 p. m. hove to. The wind increased to a moderate gale before evening and continued to blow hard throughout the night with a very rough sea.

The weather continued too rough for fishing during the 29th, and we lay to under double-reefed foresail and reefed riding sail.

April 30 began with a moderate gale from west-northwest, decreasing to a fresh breeze at noon and a gentle breeze during the evening.

During the early part of the day the vessel was headed to the northward under foresail, jib, forestaysail, and riding sail. At 11.50 a. m., tacked ship to the westward and hoisted mainsail. At 3.45 p. m., hove to and "tried" for mackerel (lat. 38° 17′ N., long. 74° 28′ W., approximately), but caught no fish.

While we were lying to, the fishing schooner *Melissa D. Robbins*, of Portland, spoke with us. Her captain told me that the steamer *Novelty* and the schooner *Mollie Adams* had taken fares of small mackerel on April 26, but I could not learn the precise locality in which these fish were caught.

At 4.30 p. m., got under way and stood to the southward 3 miles, when we hove to for the night and set gill-nets. Previous to setting the gill-nets, we put out the large towing-net and caught in it four young pollock and a number of sea-fleas. At sunset sixteen fishing vessels were in sight.

May 1, fine weather prevailed, with light variable wind in the early part of the day, increasing to a stiff breeze from west by north at 8 a. m.

At 8 a. m. we hauled the gill nets, but found no fish in them. We then got under way and ran to the southward, having a lookout at the masthead to watch for schooling fish. In company with us were twenty-four fishing-vessels, sailing practically on the same course, and spreading over a considerable area. So far as could be determined by the movements of these vessels, no indications of schooling fish were seen by any of them. At 3 p. m. tacked ship and headed north by east. The fishing fleet, which had increased to the number of forty-four sail, all tacked about the same time to the northeast. During the day we sailed southwardly to lat. 37° 12′ N., long. 74° 44′ W., without seeing any indications of the presence of surface-swimming fish.

At 6 p. m. the large towing-net was put out and towed for about forty-five minutes. Two small hake and one young pollock were taken in it. Our position at this time was lat. 37° 36′ N., long. 74° 31′ W. We then headed to the northward.

On May 2 the wind was from west-northwest to south, varying in strength from a moderate to fresh breeze.

I decided to run into Delaware Breakwater for the purpose of obtaining a supply of provisions, which we were in need of, and at 1.25 p. m. we arrived off Lewes and anchored. Immediately after I reported our arrival by telegraph to headquarters at Washington.

We remained at Delaware Breakwater until May 5. The prevailing wind in the interim was from the eastward and unfavorable for going to sea.

On May 3 the schooner *M. S. Ayres*, of Gloucester, passed the breakwater on her way to Philadelphia, having on board a fare of 70 barrels of fresh mackerel, which had been caught on the nights of the 1st and 2d of May, southeast by south 60 miles from Cape Henlopen. The captain said that only one other vessel of the fleet of forty sail of schooners caught any fish at the time that he took his.

May 5 began with pleasant weather and moderate easterly winds, but in the afternoon a dense fog came on and the wind veered from northeast to east. We got under way at 11 a. m., and, leaving the breakwater, we headed offshore for the fishing ground, steering a southeast course after passing Cape Henlopen, until 7.25 p. m., when the head sails were hauled down and we hove to for the night.

The following day (May 6) the wind was from the southeast in the morning, veering southerly as the day advanced.

At 8.25 a. m., hove to, to "try" for mackerel with "toll-bait" (lat. 38° 09′ N., long. 74° 06′ W.); caught no fish.

At 8.50 a. m., got under way steering southeast, which course was continued until 11 a. m., when it was changed, and until 5.35 p. m. the vessel made a course nearly north-northeast. Only one fishing vessel was seen during the day, and she was heading in a southerly direction. At 5.35 p. m., hove to, to "try" for fish, but did not "raise" any (lat. 38° 43′ N., long. 73° 48′ W.). We then hoisted the head sails, and put out the large towing-net, which was towed for forty minutes. There were several specimens of young hake and pollock and other forms of marine life taken in it.

May 7, the wind was southeasterly, varying from a light to fresh breeze, the weather generally clear with intervals of fog and haze.

At 1 a. m., set one mackerel and one herring gill-net (lat. 38° 52′ N., long. 73° 40′ W.). Hauled the nets at 5 a. m., but found no fish in them. At 10 a. m., in lat. 39° 12′ N., long. 73° 22′ W., tried to "raise" mackerel with "toll-bait," but failed. At 3 p. m., made another attempt with the same results, in lat. 39° 20′ N., long. 73° 08′ W. Hand-lines were also put out in the last-mentioned position and one codfish was caught. At 5.30 p. m., got under way and steered west-southwest, which course was changed to southwest later in the day. At 11.45 p. m., hove to for the night with head sails to windward.

May 8, there was a moderate breeze from south-southeast.

At 4.45 a. m., filled away and steered a SW. ½ S. course. At 10.28 a. m., hove to for mackerel, but "raised" nothing. During the morning a steamer, which resembled in appearance the fishing steamer *Novelty*, passed us to the northeast.

At 1 p. m. we spoke with the fishing schooner *Neponset*, of Boston, and her captain said that he had recently spoken with the steamer

Novelty, the latter being bound for New York with a fare of fresh mackerel, taken recently in lat. 37° 48′ N., long. 74° 35′ W. This position is given as approximate, and may vary a few miles from the exact position where the fish were taken.

During the latter part of the day we continued our course to the southwest, the four fishing vessels which were in company with us steering in the same direction. In the afternoon the weather was foggy with a moderate south-southeast wind. Between 8.20 and 9 p. m. we saw five schools of fish "firing" in the water; the bright phosphorescence caused by the movements of the fish in the water made their presence very clearly defined. By their movements I concluded the fish were mackerel. The position where these fish were seen was lat. 38° 08′ N., long. 74° 18′ W.

We continued on our southerly course until 1 a. m., on the 9th, since I was anxious to ascertain, as far as possible, the extent of area covered by the schools of fish we had seen on the previous evening, but the prevalence of foggy weather during the night prevented us from seeing schools of fish at any considerable distance from the vessel, and it is probable that if the conditions had been more favorable we might have seen many more schools than we did.

At 1 a. m. we hove to. At 5.20 a. m. made a "trial" for mackerel with "toll-bait" but caught none.

At 6 a. m. got under way and steered to the southward. At 7 a. m. sixteen fishing-vessels were seen; most of them were headed to the eastward. Soon after we spoke with the fishing schooner *Margaret Smith*, of Portland. Her captain said that he had seen an abundance of mackerel during the past eight days; the first in the latitude of Cape Henry, and about 50 miles offshore, and later he saw them in greater or less abundance, both night and day, on the ground which he had crossed over. He had, however, he said, found them extremely "wild," and difficult to catch with a purse-seine.

We next spoke with the schooner *Ralph Hodgdon*, of Gloucester. Her captain told me that he had seen several schools of mackerel, during the previous night, in the vicinity of the position we were then in (lat. 37° 48′ N., long. 74° 15′ W.), and he had also seen four large schools of fish that morning. He "shot" his seine around one of these schools, but did not catch any fish.

Captain Greenlow, master of the schooner *Carrie E. Parsons*, with whom I had an interview, said that this body of fish, which had so recently been seen, he believed to be the same that he met with on May 1 in lat. 36° 47′ N., long. 74° 53′ W. Since he met with these mackerel on the 1st, he said that he had cruised northwardly to his present position, a distance of about 60 miles, and during that time had seen large schools of fish nearly every day.

He also declared that sea-geese (Phalaropes) were so numerous during that time (May 1 to 8) that they were often exceedingly troublesome to the fishermen, since, when the mackerel would come to the surface, a large flock of these birds would light upon the water and frighten the fish, thus making it exceedingly difficult to effect a capture in the purse-seine.

At 11 a. m. we filled away and stood to the northward. At 3 p. m. had a "trial" for mackerel with "toll-bait," but caught nothing. We then continued our course to the northward until 8 p. m., when we hove to and set two gill-nets in lat. 38° 10′ N., long. 74° 11′ W. The wind at this time was east-northeast, with foggy weather.

Before setting the gill-nets, the small surface towing net was put out and a large amount of copepods was taken in it. It was evident that "mackerel feed" was abundant.

On May 10 there was a moderate to fresh easterly wind and foggy weather until late in the day, when the fog cleared.

At 4 a. m. hauled the gill-nets. Fourteen mackerel were caught in the herring gill-net and seven mackerel in the mackerel net. These fish ranged from 11 to 12½ inches in length. Specimens were saved and the remainder of the fish carefully eviscerated and their stomachs were preserved in alcohol.

A mackerel shark, which was entangled in the net, was also taken in this haul. The fish was skinned by Dr. Bean, who preserved the skin for the National Museum.

At 6 a. m. hove to to "try" for mackerel with "toll-bait," but without success.

The continuance of foggy weather and a fresh easterly wind, which prevailed during the greater part of the day, made it so difficult to make observations that, after finishing the trial for mackerel, we lay by jogging with head sails to windward. At 4.10 p. m. the fog cleared, and eight fishing schooners were seen to the southeast of us. Soon after we filled away to the northward, close hauled by the wind.

At 6.40 p. m. put out the large and small towing nets and towed them for half an hour. In the small net some copepods were taken, while specimens of young pollock and hake were obtained in the larger net.

On the 11th, fog prevailed during the greater part of the day, with calms and light to moderate variable winds.

At 6.15 a. m. hove to to "try" for mackerel with "toll-bait," but caught nothing.

When the weather cleared in the afternoon we saw twelve fishing-vessels and one barkentine. The former were mostly to the southwest of us, the most distant vessel about 6 miles away; they were heading to the northeast.

At 2.30 p. m. I went on board of the schooners *Warren J. Crosby* and *Mollie Adams*, both from Gloucester. Each of these vessels had taken small catches of mackerel, principally mixed fish, during the previous night. Captain Jacobs, of the *Mollie Adams*, had taken a small school of large-sized mackerel, some individuals measuring from 13 to 15 inches in length. He expressed his belief that six or seven vessels of the fleet had obtained fares of mackerel during the night and had sailed for market. During the latter part of the day we steered a northeast course. At 7.30 p. m. we hove to and set two mackerel gill-nets and one herring gill-net in lat. 38° 30′ N., long. 73° 55′ W.

During the evening we saw torches burning on board of several fishing vessels to the northwest, which indicated that those vessels had taken catches of mackerel, or were among the schooling fish.

The following morning (May 12) the wind was easterly, blowing a moderate breeze; the weather clear and pleasant.

At 4.30 a. m. hauled the gill-nets and found one mackerel in the herring net, and a few small dogfish. As soon as the nets were on board we got under way and stood to the northward in the direction of a fishing vessel which we saw "lying to" under her mainsail, and the crew of which were busy dressing fish. The vessel proved to be the *Warren J. Crosby*, of Gloucester, and her captain reported catching 70 barrels of mackerel during the previous night. These mackerel, he said, ranged from 11 to 13 inches in length. Shortly after we spoke with the schooner *Lizzie Maud*. Her captain reported leaving New York the day before. Up to that time, he said, about twenty-five vessels had landed fares of mackerel at that port, most of the fish being taken between the parallels of 37 and 38° 40′ north, from 15 to 25 miles offshore. All vessels landing fish reported that the body of fish from which they obtained their catches covered an area of about 25 to 30 miles north and south, and about 15 miles from east to west, and had occupied that position for nearly ten days. At 8 a. m. twenty-seven sail of fishing vessels were seen, most of them "jogging." Put out the small towing net and collected some crustacea and a lot of minute shells which were floating in the water. We made a trial with "toll-bait" for mackerel in the evening (lat. 38° 40′ N., long. 73° 55′ W.) but got no fish. In an interview with Captain Chase, of the schooner *Clara S. Cameron*, he said that the body of mackerel seen by him this spring exceeds in amount anything he has experienced while engaged in the southern mackerel fishery.

At 6.57 p. m., put out the large towing net and took a quantity of crustacea and small floating shells, our position being lat. 38° 40′ N., long. 73° 55′ W. The vessel was headed to the northwest during the night, and a lookout was stationed at the mast-head to watch for fish. Saw nine schools of fish between 9 and 10 o'clock p. m.

On the morning of May 13 the wind was west-southwest, hauling to northwest and northeast later in the day. At 7 a. m. our course was southwest by south ½ south, seven fishermen in sight, steering in the same direction. We sailed 57 miles in this direction, and saw three fishermen ahead "haul to" and drop their seine-boats; soon after we saw five large schools of fish. The seine-boat of the schooner *Henry Morganthau*, of Portland, was seen taking mackerel. The Morganthau soon "hove to" alongside of her boat to "bail out" the fish from the seine. I went on board of her. The catch was estimated at about 200 barrels; and the fish ranged from 11½ to 13½ inches in length. Two other vessels made hauls of mackerel later in the evening. The position in which these fish were taken was lat. 37° 48′ N., long. 74° 13′ W. We afterwards learned that other schooners took fish in about the same locality, as well as 20 miles to the westward. We hove to for the night at 8 p. m., with head sails to windward.

On the morning of May 14 the wind was moderate from east-southeast, veering to northeast by east at 4.30 a. m., and increasing to a fresh breeze. At 11.20 a. m. there were forty sail of fishing vessels to the southwest of us. On account of the extremely rough weather no trials for fish were made during the day.

May 15 the wind was light and variable. We spoke with the schooner *Lizzie W. Smith* and told her captain of the recent catches of mackerel. At 7 a. m., made a "trial" for mackerel with "toll-bait" (lat. 38° 01′ N., long. 74° 18′ W.), but got nothing. We then got under way and steered northwest by the wind; later, we changed the course to northeast and ran 32 miles in that direction. At 8.50 p. m., spoke with the schooner *Edward E. Webster*, of Gloucester. Her captain reported taking a fare of 125 barrels of mackerel that evening, in lat. 38° 41′ N., long. 74° 16′ W. We ran 12 miles farther to the northeast from this position and saw thirty-two large schools of fish. After leaving the fleet we saw only two fishing schooners. We hove to for the night at 11 p. m.

On the following day (May 16) the wind was from northeast to northeast by north.

Being short of supplies, we set all light sails at 12.30 p. m., and headed for Delaware Breakwater, where we arrived and anchored at 8.05 p. m. There were four mackerel schooners, several coasting vessels, and the U. S. cruiser *Hamilton*, at anchor at the Breakwater.

On May 17 there was an easterly wind and heavy swell. After obtaining the necessary supplies for the vessel, I went on board of the menhaden steamer *Nellie E. Rawson*, and learned from her master, Captain Steelman, that the first catch of menhaden this year was made on the previous day, the 16th instant, and that the fish were fifteen days later than usual. I was also informed by Captain Valiant, who commands another menhaden steamer, that small bodies of menhaden had been moving northward past the Delaware since the 2d of May.

Both captains said that during August of last year quantities of mackerel, 7 or 8 inches in length, were seen between Hereford Inlet and Barnegat. In the afternoon two other fishing-vessels anchored at the Breakwater.

May 18 began with a moderate wind from southeast to east-southeast, which increased to a fresh breeze in the afternoon. A fishing-schooner arrived in the afternoon and reported a rough sea and foggy weather outside.

I learned from Captain Thomas, of the fishing-schooner *Maud S.*, that on May 10, in latitude 37° 07′ N. and about longitude 74° 40′ W., he took 47 barrels of mackerel. These fish were apparently a part of the same body of mackerel seen on that date in latitude 38° 10′, which would convey the idea that the schooling fish covered something over a degree of latitude.

On May 19 the weather was clear and fine. At 9 a. m., got under way, but on account of light wind we were compelled to anchor again; 1.20 p. m. got under way with a light east-southeast wind which hauled to south-southwest, and after passing Cape Henlopen we steered east by south ½ south. Passed eight schools of menhaden between 6.40 and 8 p. m., about 18 miles off shore. Put out the small towing net in the evening and took an abundance of crustacea and other objects which we supposed to be fish eggs.

May 20 began with a gentle breeze from south-southwest to southwest, with foggy weather. Put out the small towing net and collected a lot of crustacea and some fish eggs. At 6.15 a. m., hove to and "tried" for mackerel with "toll-bait," also put out hand-lines baited with fresh clams for bottom fish, but got nothing. Our position was lat. 38° 42′ N., long. 70° 31′ W. Got under way again at 7.55 a. m.; saw fish schooling some distance from the vessel at 11 a. m., but could not determine the species. Changed our course to northeast by east at 2 p. m. The fog lifted at 5.50 p. m., and we saw fishing-vessels to the northeast of us. Put out the large and small towing nets and took some small fish in the former and an abundance of crustacea in the latter (lat. 38° 50′ N., long. 74° 06′ W). At 8 p. m. the fog set in and the vessel was hove to for the night, with head sails to windward.

The following day (May 21) the wind was from southwest to west, accompanied by foggy weather until 3 p. m. Got under way at 3.25 a. m., steering northeast by east. Spoke with a pilot-boat at 11 a. m., and was informed that there were plenty of mackerel off shore 14 to 20 miles southeast of Barnegat. We ran on the northeast by east course, 16 miles; changed to north-northeast, and sailed 14 miles, and then stood to the north by west for 13 miles. Spoke with the fishing-schooner *Margaret Smith*, of Portland, at 5 p. m., steering to the eastward, and told her captain what I had learned from the captain of the pilot-boat; she afterwards changed her course to the northward. Between 9.30 and 10.30 p. m. we passed through about twelve schools of fish. At 10.30 p. m. hove to for the night under mainsail, and set one mackerel and one herring gill-net at the surface (lat. 39° 40′ N., long. 73° 38′ W).

The wind on May 22 was moderate from southwest to west-southwest, with foggy weather. Hauled the nets and found three male and one female branch alewives in them. At 8 a. m., used the small towing net (lat. 39° 43′ N., long. 73° 49′ W.), took a small quantity of *entomostraca*. Surface annelids were taken in a dip-net about the same time. At 8 a. m., we stood to the northwest, and at 9.45 a. m. hove to and "threw" "toll-bait" for forty five minutes, also used the hand-lines; caught no fish. At this time the weather was so foggy that we hoisted the jibs and hove to with head sails to windward.

During the afternoon the foresheet was eased off and the hand-lines put overboard. Dr. Bean caught a hake weighing 6 or 7 pounds. The fog partially cleared in the afternoon, and at 5.30 p. m. we spoke with the schooner *John G. Whittier*. Her captain wanted information in regard to the fleet and mackerel. Soon after we filled away and stood on a northwest course for 11 miles. We then hove to and "tried" for mackerel with "toll-bait" (lat. 39° 34′ N., long. 73° 55′ W.), but "raised" no fish. The small towing-net was used (lat. 39° 45′ N., long. 73° 49′ W.) about 8 p. m., and we took an abundance of crustacea and young hake and pollock. We hove to for the night at 9 p. m., with head-sails to windward. A dense fog set in, which lasted until 5 a. m. the following day. We saw five schools of fish between midnight and 4 o'clock a. m., all of which were working to the northeast.

We filled away at 4.20 a. m. on May 23 and steered north-northeast, 5 miles, then ran 15 miles in a north by east direction, changed the course to northwest by north, and sailed 4 miles; then stood to the northeast for 18 miles; changed again to north-northeast, ran 12 miles, and changed to northeast by east and stood in that direction 13 miles. Saw several fishing-vessels to the northeast of us at 11.20 a. m. At 1.55 p. m. spoke with the schooner *Porter S. Roberts*, of Gloucester. Captain Greenleaf reported having cruised from the latitude of Cape Henry to his present position without seeing fish. At 12.35 hove to and "tried" for mackerel in lat. 40° 06′ N., long. 73° 28′ W., but did not succeed in getting fish. After this we got under way and stood to the northward. Spoke with the fishing-schooner *Joe Hooker*, of Boston (lat. 40° 17′ N., long. 73° 10′ W.), and her captain reported seeing a large body of fish in this vicinity last evening. At the time of speaking with the *Hooker* thirteen sail of vessels were in sight, extending some 10 miles east and west and 4 or 5 miles north and south. At 8.03 p. m. hauled the head-sails to windward and "jogged" on the starboard tack.

May 24 began with a very fresh south-southwest wind. At 6.15 a. m. kept off and steered east-northeast 30 miles, when we hove to and "tried" for mackerel (lat. 40° 41′ N., long. 72° 09′ W.). Finishing the trial we got under way and continued our course to the northeast. At 3 p. m. sighted Montauk Point, bearing north by west, about 5 miles distant. We then changed the course to southeast by east, four fishing-vessels being seen in that direction. During the afternoon spoke with the schooner *William H. Foy*, of Gloucester. Her captain reported having cruised to the eastward of Block Island, but did not see any mackerel. At 4.18 p. m. hove to and "tried" for mackerel about 13 miles south-southeast from Montauk Point. This trial, as well as all *others up to this* date, proved fruitless. The wind being from the south and the weather threatening we headed the vessel for Fort Pond Bay (in company with eight fishing-schooners, which were running in for shelter), where we arrived and came to anchor at 8 p. m.

May 25 began with an easterly wind, foggy and rainy weather. Went on board of the menhaden-steamer *Victor* in the forenoon and learned from Capt. Henry C. Fish that the first fish taken by the menhaden steamers of this vicinity were caught on the 12th of May, off Barnegat, and others were taken off Shinnecock on the 16th instant. He stated that menhaden were numerous off Montauk, but in very small schools. It was his opinion that the main body of fish had not then made its appearance; usually they reach Long Island Sound about the middle of June and pass northwards as far as Buzzard's Bay. There were twenty-nine steamers, he said, engaged in the menhaden fishery in that vicinity.

Captain Chase, of the schooner *Clara S. Cameron*, reported having seen large bodies of fish southwest ½ south, 45 miles from Shinnecock, on the evening of the 23d; the fish were swimming too deep to ascertain the species.

The fog disappeared at 6 a. m. on May 26, the wind being moderate from south by west to southwest. Got under way at 7 a. m., and headed toward Montauk. Made towing with small tow-net at 8 a. m., and found crustacea and fish eggs very abundant. While in a calm off Great Pond we put out the hand-lines and caught a large sea bass. Montauk Point bore abeam at 10.50 a. m., and we shaped our course so as to pass 5 or 6 miles to the southward of Block Island. We saw a school of pollock south by east, 5 miles from Block Island. "Tried" for mackerel with "toll-bait" south by east, 5 miles from the western point of Block Island, but notwithstanding that this trial continued for half an hour no fish were "raised." It became evident, at this time, that the weather would be very unfavorable for the continuance of the investigation during the rest of the day, and I decided to run into Newport; accordingly we came to anchor in the outer harbor at 7.45 p. m. I telegraphed to Wood's Holl to have the vessel's mail forwarded to Newport.

May 27 began with a moderate wind from south-southwest; weather foggy until 7.30 p. m. Went on board of the fishing-schooner *Hattie Evelyn*, of Gloucester, during the evening, and was informed by Captain Cromwell that he saw large bodies of mackerel on May 18 in lat. 39° 21′ N., long. 73° 39′ W. He followed them to lat. 39° 56′ N., long. 72° 46′ W., and there lost sight of them. The vessel's mail arrived at 6 p. m.

On the following day (May 28) there was a moderate wind from north-northeast, which increased to a fresh breeze at noon, with threatening weather, mist and rain at intervals. About twenty fishing vessels had arrived in the harbor for shelter at 8 p. m. Went on board of the schooner *Elsie Smith*, of Portland, Me. Her captain reported having secured, on May 27, 50 barrels of mackerel south-southeast of Block

Island about 15 miles. At the time he took his fish there were eighteen other fishing vessels present, of which twelve secured fares. The mackerel ranged from 10 to 13 inches in length.

Captain Thomas, of the schooner *Mary H. Thomas*, informed me that he was among the fleet on May 27, and secured two schools of mackerel and alewives mixed. I learned from Captain Harty, of the schooner *I. J. Merritt*, that about 40 miles southeast ½ south from Block Island he saw twelve schools of fish, but did not attempt to take them no account of threatening weather. He also said that he had recently marketed a catch of 194 barrels of salt and 125 barrels of fresh mackerel, which he caught on May 21 and 22 while cruising from southeast of Barnegat to southeast of the light-ship off Sandy Hook. There seemed to be a large body of fish, which, he thought, were working to the northward.

The low barometer and threatening weather continued throughout the whole of the 29th.

Got under way at 5 a. m. on May 30 and headed to sea, accompanied by fifteen sail of the fishing fleet, the wind at that time being moderate from north-northeast. Put out the small towing-net when outside of the harbor, and secured a large amount of fish-eggs. Young pollock, hake, and lumpfish were abundant. At 1 p. m. the wind was from the south and the vessel heading southeast, close hauled on starboard tack. About this time the lookout at the mast-head reported one of the accompanying vessels dropping her seine-boat for fish.

At 1.30 p. m. saw six schools of fish, and worked up near them and threw "toll-bait," hoping to determine the species by this means. Position, lat. 41° 12′ N., long. 71° 09′ W. Later we hoisted out a dory and sent two men to ascertain the species. They reported alewives at the surface, but thought it probable that mackerel were mixed with them. Subsequently we saw several schools of fish swimming with their heads out of the water, which we thought to be mackerel. Sent two men in a dory equipped with hand-lines and "toll-bait," and instructed them to throw bait in the center of the schools and secure as many specimens as possible. They were unsuccessful, however. This position was about 10 miles west-southwest from Gay Head. We used the towing net here and got a lot of small crustacea, such as is usually called "seed," or "mackerel feed," by the fishermen. At 7 p. m., when about 9 miles southwest ½ west of No Man's Land, we put out the large towing-net for thirty minutes, and secured five young hake. The vessel was hove to for the night at 7.35 p. m. During the day we noticed that a large portion of the fleet had their jibs down and seine-boats out, which indicated that fish had been captured.

In the early morning of May 31 the weather was foggy, with an easterly wind, which increased to a fresh breeze at daylight. At 5 a. m. the fog cleared, and soon after we filled away, steering northeast ½ north, for Vineyard Sound.

Having received orders directing me to report at Wood's Holl on or about June 1 the vessel was headed for that place and anchored off the Fish Commission wharf at 1.30 p. m. Later in the evening the vessel was hauled alongside of the wharf.

During the day (June 1) we landed the collections made on the cruise and prepared them for shipment to Washington; also put ashore some nets and other apparatus for storage in the Fish Commission building. Took on board halibut trawls and buoys, to be used on the contemplated trip to the Gulf of St. Lawrence.

June 2 the weather was rainy and foggy. At 10.30 a. m. hauled out into the stream and anchored.

My orders directed me to report at Gloucester after landing the material collected on the cruise. Accordingly got under way at 8 a. m. on June 3, with the wind from south by west to southwest by south blowing a moderate to fresh breeze. Passed the Highlands of Cape Cod and hove to at 11 p. m.; weather very foggy. The fog cleared at 2 a. m. on June 4, and we continued our course for Gloucester, where we anchored at 4.40 a. m.

Temperature of air and water.

[These temperatures all taken at the surface.]

Date.	Air.	Water.	Date.	Air.	Water.	Date.	Air.	Water.
1887.	°	°	1887.	°	°	1887.	°	°
April 7, 1 a. m.	38	40	April 28, 11 a. m.	50	48	May 15, 5 a. m.	54	54
April 7, 7 a. m.	42	42	April 28, 3 p. m.	52	47	May 15, 12 m.	57	55
April 7, 4 p. m.	48	46	April 29, 7 a. m.	50	47	May 15, 6 p. m.	55	55
April 8, 1 a. m.	45	47	April 29, 2 p. m.	50	45	May 16, 4 a. m.	52	54
April 8, 1 p. m.	47	46	April 29, 8 p. m.	46	45	May 16, 8 a. m.	55	52
April 8, 8 p. m.	45	48	April 30, 11 a. m.	50	45	May 16, 2 p. m.	57	54
April 9, 12 m.	54.9	49	April 30, 4 p. m.	49	45	May 17, 4 a. m.	52	58
April 9, 2 p. m.	53	51	May 1, 4 a. m.	47	46	May 17, 4 p. m.	60	59
April 9, 8 p. m.	48	49	May 1, 4 p. m.	52	49	May 20, 9 a. m.	65	57
April 10, 6 a. m.	49	48	May 2, 10 a. m.	53	48	May 20, 12 m.	68	57
April 10, 1 p. m.	53	47	May 2, 1 p. m.	55	49	May 20, 3 p. m.	69	60
April 10, 6 p. m.	50	45.5	May 3, 4 a. m.	55	51	May 20, 6 p. m.	56	59
April 11, 1 a. m.	50	45	May 3, 2 p. m.	62	51	May 20, 12 mid.	57	53
April 11, 11 a. m.	52	47.5	May 4, 9 a. m.	55	50	May 21, 5 a. m.	57	57
April 11, 4 p. m.	58	50	May 4, 1 p. m.	55	55	May 21, 10 a. m.	60	57
April 12, 12 m.	50	45	May 5, 6 a. m.	55	50	May 21, 2 p. m.	68	58
April 12, 7 p. m.	47	45	May 5, 1 p. m.	55	56	May 21, 8 p. m.	60	58
April 13, 6 p. m.	46	44.5	May 5, 6 p. m.	52	51	May 21, 12 mid.	62	60
April 13, 10 p. m.	50	50	May 5, 10 p. m.	52	56	May 22, 2 a. m.	61	59
April 14, 5 a. m.	49	49.5	May 6, 2 a. m.	52	51	May 22, 6 a. m.	61	60
April 14, 1 p. m.	50	45	May 6, 11 a. m.	55	50	May 22, 12 m.	60	60
April 14, 12 mid.	48	49	May 7, 2 a. m.	54	52	May 22, 7 p. m.	62	61
April 15, 5 a. m.	48	46	May 7, 11 a. m.	55	51	May 23, 5 a. m.	61	59
April 15, 1 p. m.	48	48	May 7, 5 p. m.	58	51	May 23, 6 a. m.	60	60
April 16, 8 a. m.	47	46.2	May 8, 12 m.	58	54	May 23, 12 m.	60	60
April 16, 8 p. m.	50	51	May 8, 8 p. m.	55	52	May 23, 8 p. m.	60	60
April 17, 1 a. m.	49	50	May 9, 3 a. m.	58	52	May 24, 3 a. m.	60	57
April 17, 4 a. m.	49	49	May 9, 9 a. m.	55	55	May 24, 11 a. m.	63	57
April 17, 6 a. m.	50	59	May 9, 4 p. m.	60	56	May 24, 3 p. m.	65	54
April 17, 8 a. m.	46	45	May 10, 5 a. m.	55	54	May 24, 8 p. m.	55	51
April 17, 12 m.	50	50	May 10, 10 a. m.	57	54	May 26, 5 a. m.	60	52
April 17, 7 p. m.	46	47	May 10, 3 p. m.	59	54	May 26, 2 p. m.	65	52
April 18, 10 a. m.	54	44	May 11, 7 a. m.	55	53	May 26, 8 p. m.	56	52
April 18, 5 p. m.	60	52	May 11, 12 m.	59	55	May 30, 4 a. m.	52	54
April 23, 11 a. m.	50	45	May 11, 3 p. m.	62	56	May 30, 9 a. m.	55	55
April 24, 2 a. m.	52	48	May 11, 8 p. m.	60	54	May 30, 3 p. m.	55	55
April 24, 2 p. m.	50	46	May 12, 2 a. m.	56	55	May 31, 2 a. m.	51	52
April 25, 4 a. m.	49	47	May 12, 12 m.	60	55	May 31, 11 a. m.	53	55
April 25, 3 p. m.	48	45	May 12, 3 p. m.	60	56	May 31, 1 p. m.	55	55
April 26, 8 a. m.	45	49	May 13, 4 a. m.	57	55	June 3, 10 a. m.	60	58
April 26, 11 a. m.	50	53	May 13, 11 a. m.	60	55	June 3, 12 m.	52	52
April 26, 3 p. m.	50	45	May 13, 5 p. m.	58	55	June 3, 2 p. m.	63	48
April 27, 4 a. m.	48	46	May 14, 5 a. m.	54	55	June 3, 4 p. m.	63	50
April 27, 10 a. m.	48	46	May 14, 10 a. m.	56	54	June 3, 7 p. m.	56	50

Table showing position, method of investigation, and results of trials for fish.

Date.	Hour.	Lat. N.		Long. W.		Locality.	Method of investigation.	Time occupied.	Results.
1887.		°	′	°	′				
Apr. 8	1.34 p. m.	37	23	74	45	Off Va	Toll-bait	45 minutes	Nothing.
8	5 12 p. m.	37	04	74	37	do	do		Do.
8	5.12 p. m.	37	04	74	37	do	Hand-lines		Two spiny-backed dog-fish.
8	6.30 p. m.	37	04	74	37	do	Gill-nets	Over night	Twenty-one alewives and two mackerel.
9	6.20 p. m.	36	45	74	53	do	Toll-bait	1 hour	Nothing.
10	5.45 a. m	36	29	74	50	do	do	do	Do.
10	5.45 a. m.	36	29	74	50	do	Hand-lines	do	Dog-fish.
10	10 a. m	36	04	74	44	do	Toll-bait	do	Nothing.
11	5.40 a. m.	37	22	74	39	do	do	do	Do.
11	5.40 a. m	37	22	74	39	do	Hand-lines	do	Dog-fish.
11	3.25 p. m.	36	58	74	49	do	Toll-bait	40 minutes	Nothing.
11	6.15 p. m.	36	51	74	34	do	Gill-nets	Over night	One menhaden.
12	6.30 p. m.	37	32	74	52	do	do	do	Two butter-fish.
17	10 p. m.	36	45	74	50	do	do	do	Nothing.
24	5.35 p. m.	37	34	74	26	do	Toll-bait		Dog-fish.
24	7 p. m.	37	34	74	26	do	Gill-nets	Over night	Nothing.
26	5.30 p. m	37	23	74	01	do	Toll-bait	30 minutes	Do.
26	5.30 p. m.	37	23	74	01	do	Hand-lines	do	Dog-fish.
27	9.30 a. m.	37	43	74	15	do	Toll-bait	do	Nothing.
27	9.30 a. m.	37	43	74	15	do	Hand-lines	do	Six hake.
27	5.25 p. m.	37	43	74	15	do	Toll-bait	do	Pollock and hake.
28	8.30 a. m.	37	40	74	13	do	do	do	Nothing.
30	3.45 p. m.	38	17	74	28	Off Del	do	do	Do.
30	7.15 p. m.	38	17	74	28	do	Gill-nets	Over night	Do.
May 6	8.25 a. m.	38	09	74	06	do	Toll-bait	30 minutes	Do.
6	5.35 p. m.	38	43	73	48	do	do	do	Do.
7	1 a. m.	38	52	73	40	do	Gill-nets	Over night	Do.
7	10 a. m.	39	12	73	22	do	Toll-bait	30 minutes	Do.
7	8 p. m.	39	20	73	08	do	do	do	Do.
7	3 p. m.	39	20	73	08	do	Hand-lines	do	One codfish.
8	10.28 a. m	38	25	74	06	do	Toll-bait	do	Nothing.
9	5.20 a. m	37	46	74	15	do	do	do	Do.
9	3 p. m.	38	18	74	11	do	do	do	Do.
9	8 p. m.	38	18	74	11	do	Gill-nets	Over night	Twenty-one mackerel and one mackerel shark.
10	6 a. m.	38	18	74	11	do	Toll-bait	30 minutes	Nothing.
11	6.15 a. m.	38	11	74	23	do	do	do	Do.
11	7.30 p. m.	38	30	73	55	Off N. J	Gill-nets	Over night	One mackerel and dog-fish.
12	p. m	38	40	73	55	do	Toll-bait	30 minutes	Nothing.
15	7 a. m.	38	01	74	18	Off Del	do	do	Do.
20	6.15 a. m	38	42	74	31	Off N. J	do	do	Do.
20	6.15 a. m.	38	42	74	31	do	Hand-lines	do	Do.
21	10.30 p. m	39	40	73	38	do	Gill-nets	Over night	Four alewives.
22	9 45 a. m.	39	39	73	41	do	Toll-bait	30 minutes	Nothing.
22	9.45 a. m.	39	39	73	41	do	Hand-lines	do	Do.
22	4 p. m.	39	39	73	41	do	do	do	One hake.
22	7 p. m.	39	34	73	55	do	Toll-bait	do	Nothing.
23	12.35 p. m	40	06	73	28	do	do	do	Do.
24	10 a. m	40	41	72	09	do	do	do	Do.
24	4.18 p. m.					S. SE. Montauk	do	do	Do.
26	a. m.					Off Great Pond	Hand-lines	do	Sea-bass.
30	1.30 p. m.	41	12	70	09	Off Block Island	Toll-bait	do	Nothing.

NOTES ON THE CRUISE OF THE GRAMPUS ON THE SOUTHERN MACKEREL GROUNDS DURING THE SPRING FISHERY OF 1887, BY TARLETON H. BEAN.

The first voyage of the *Grampus* was made during the latter part of March and the early part of April well to the southward, and resulted in the discovery of the first mackerel of the season April 8, off Smith's Island, in Chesapeake Bay, north latitude 37° 14′, west longitude 74° 39′. Besides mackerel, the gill-nets captured alewives and menhaden, and collections of the minute crustaceans, on which mackerel are known to subsist, were taken in towing-nets. At the end of the first voyage the *Grampus* came to Fortress Monroe, where the writer joined her, April 20, to make further collections of marine fishes and of the surface invertebrates upon which the fishes feed, with especial reference to the mackerel, the bluefish, and the menhaden. It was also part of our duties to seek new fishing grounds and to collect birds and other associates of the mackerel.

The vessel was temporarily commanded by Capt. D. E. Collins, who has obtained the information given below with reference to the movements of the fleet and the localities in which catches of mackerel were made. The *Grampus* was supplied with towing-nets, gill-nets, lines of various kinds, and with toll-bait for luring fish. She had also a very liberal outfit of apparatus for general collecting, including nearly everything carried by sea-going exploring vessels, with the exception of the beam trawl.

The instructions to the *Grampus* involved her cruising primarily with the fishing fleet after the mackerel had been located, but she was expected also to look independently outside of the limits occupied by the fleet to ascertain whether or not mackerel could be found in advance of the fishing centers, or in any other direction outside, inside, or behind the position of the fleet.

During the early portion of the fishing season the vessel extended her researches southward almost to Cape Hatteras, but she caught no mackerel until the 8th of April, off Chesapeake Bay. The investigation was continued northward to Vineyard Sound, closing at Wood's Holl, May 31.

AREA INVESTIGATED BY THE GRAMPUS.

From April 22 to May 2 the cruising ground was from north latitude 37° 16′ to 38° 24′, west longitude 75° 20′ to 73° 56′. From May 5 to May 16 we sailed over the region from north latitude 37° 45′ to 39° 20′, west longitude 74° 36′ to 73° 19′. From May 19 to May 31 we were cruising offshore between Five Fathom Bank light-ship (entrance to Delaware Bay) and Vineyard Sound, keeping generally within the area occupied by the fleet.

BAD WEATHER ENCOUNTERED.

From April 22 to May 2 we encountered very bad weather, which operated unfavorably to the mackerel fishery. During all this time there was but one day when the conditions were favorable for the schooling of fish at the surface. The schools that we observed during this time were almost invariably too deep to be seined, and it is quite probable that the great mass of the fish passed northward unobserved. In the region traversed by us the schooling fish were seen principally at night, and we could not tell with certainty whether they were mackerel alone or a mixture of several species.

Our last cruise was marked also to a large extent by bad weather, cold easterly and southeasterly winds, with fog. The result of this unpropitious weather was a very light catch and an unprofitable fishery.

THE FLEET.

During our first cruise we observed as many as fifty sail all in sight at the same time. The majority of these vessels had been on the grounds fully six weeks, and yet their catch up to the 1st of May scarcely amounted to a good fare for a single vessel. During the second cruise we never saw more than fifty vessels at one time, and the bulk of the fleet were rarely in the centers of abundance of fish. On the 11th of May we counted fourteen vessels, extending in a semi-circle from southeast to northwest, the most distant ones being 6 or 7 miles from us.

May 12, in latitude 38° 34′, longitude 74° 15′, we counted forty-four sail.

May 13, in latitude 37° 48′, longitude 74° 13′, there were eleven sail in sight, several of which caught mackerel measuring from 11 to 13½ inches, in quantities ranging up to about 200 barrels.

May 14, at noon, in latitude 38° 09′, longitude 74° 25′, forty sail were counted from aloft.

May 15 the *Grampus* was on her way to Delaware Breakwater, and during that evening, before the moon rose, we sailed through great masses of fish about 15 miles to the southward of Five Fathom Bank light-ship. We had left the majority of the fleet far to the southward, and only two vessels were catching fish as we came along. We then went into Delaware Breakwater, where we were detained several days, and after starting upon the final cruise we saw only occasional fishermen until in the evening of May 23, in latitude 40° 19′, longitude 73° 06′, thirteen sail were in sight all jogging. On this day we spoke a pilot-boat, which reported a fleet May 20 of about twenty-five sail 30 miles southeast from Barnegat in the midst of an abundance of fish; but foggy weather interfered with the fishing. We then cruised along in the waters off Long Island, lying to at night and using our nets whenever the weather permitted.

May 24 we were obliged to make a harbor in Fort Pond Bay, eastern end of Long Island, where we were detained until the 26th by fog. Eight vessels left in company with us. After passing Montauk these vessels sailed about east-southeast, and were joined by several coming from the westward. We saw two seiners anchored at Block Island and ten in the harbor of Newport.

May 29 there were about twenty mackerel fishermen in Newport Harbor, several of which left with their boats on deck, probably bound home.

May 30 there were about twenty-seven sail among the fish, 10 or 12 miles east-southeast from Block Island.

May 31 there were twenty-one sail in the vicinity of No Man's Land and Martha's Vineyard, mostly working towards Vineyard Sound. Some vessels, however, abreast of No Man's Land had their jibs to windward. At 10.15 of this day as we were tacking through Vineyard Sound I counted 16 fishermen jogging to the northwest of No Man's Land, while several others were working through Vineyard Sound.

NOTES ON FISHES.

LOPHIUS PISCATORIUS.

April 23. A few young examples were caught in a purse-seine by Capt. Sol Rowe, 30 miles off Hog Island, in company with *Prionotus*, *Clupea*, *Squalus*, and young *Scomber*.

May 12. In north latitude 38° 40′, west longitude 73° 53′, a young individual about a centimeter long was taken at the surface.

May 30. See under "Fish Eggs" an account of the egg-masses seen in Narragansett Bay.

HIPPOGLOSSOIDES, sp. ?

May 22. In about north latitude 39° 45′, west longitude 73° 40′, four young examples of a flounder which appears to be *Hippoglossoides platessoides* were taken at the surface at 8 in the evening; the largest is 17 millimeters long, its dorsal fin has about 80 rays, and traces of several cross-bands on the sides are plainly visible as in young *Aphoristia;* the tail is somewhat produced and tapering.

CITHARICHTHYS, sp.

April 27. Some specimens were found in stomachs of hake in north latitude 37° 43′, west longitude 74° 15′.

HIPPOGLOSSUS VULGARIS.

Captain Williams, of the *G. P. Whitman*, says that he knows of the capture of this fish off the Delaware coast.

CORYPHÆNOIDES RUPESTRIS.

A single specimen was found floating alive at the surface in north latitude 36° 50′, west longitude 74° 33′, by Capt. Sol Rowe, of the schooner *William H. Foye.*

POLLACHIUS VIRENS.

April 27. Two young individuals were taken in the towing-net in north latitude 37° 43′, west longitude 74° 15′. A large example weighing about 20 pounds was caught in the same locality, in the evening, by Captain Collins. In its stomach was a large squid.

April 30. Four young examples were taken in north latitude 38° 12′ 45″, west longitude 74° 26′.

May 1. At 6 p. m., in north latitude 37° 36′, west longitude 74° 31′, a young example was caught in the large tow-net.

On the 6th of May, in latitude 38° 43′ N., longitude 73° 48′ W., young examples were obtained in the towing-net, and in the evening of May 10, in north latitude 38° 11′, west longitude 74° 02′, young specimens were caught in the same net. On the evening of May 22, in about north latitude 39° 45′, west longitude 73° 49′, a young example was taken in the towing net.

May 26 a school of pollock was seen at the surface by the *Grampus*, between Montauk and Block Island. A large one was caught on a bluefish drail.

Young specimens caught in dip-net, May 30, under floating rock-weed.

GADUS MORRHUA.

May 7. A single fine cod was caught from the *Grampus*, using menhaden for bait, in about north latitude 39° 20′, west longitude 73° 09′.

Capt. D. E. Collins has seen cod in the well of the *Grampus* swinging on their heads as a pivot.

PHYCIS, sp.

May 1. At 6 p. m. two young individuals were taken in the towing-net, in north latitude 37° 36′, west longitude 74° 31′.

May 6. In north latitude 38° 43′, west longitude 73° 48′, young hake were taken in the towing-nets.

May 10. One young example was taken in north latitude 38° 06′, west longitude 74° 13′, and in the evening in north latitude 38° 11′, west longitude 74° 02′, more of the young were obtained.

May 12. Young specimens were caught in the dip-net, and in the evening in north latitude 38° 40′, west longitude 73° 53′, the large towing-net took three young examples.

May 20. In north latitude 38° 50′, west longitude 74° 06′, young hake were obtained in the towing-net.

May 22. At 8 p. m., in about north latitude 39° 45′, west longitude 73° 49′, a young specimen was obtained in the towing-net.

May 30. About 9 miles southwest ½ west from No Man's Land five young hake were obtained in the towing-net, the largest of them nearly 2½ inches long. Young specimens were caught in dip-net; others, under floating rock-weed.

PHYCIS CHUSS.

May 22, in about north latitude 39° 36′, west longitude 73° 37′, using fresh clams for bait, the *Grampus* took a small male of this species. In its stomach were large *Amphipods.* Its spermaries were white and well developed.

May 30, in about north latitude 41° 12′, west longitude 71° 09′, an individual of this species was caught on the hand-line. On the same day, about 14 miles southwest ½ west from Gay Head, several small examples were again taken by the same method.

PHYCIS TENUIS.

In the morning of April 27, with pork bait, we caught six hake in north latitude 37° 43′, west longitude 74° 15′, at a depth of 36 fathoms. In weight the fish ranged from about 3 to 12 pounds. In their stomachs were the pen of a squid, a *Citharichthys*, and another fish which was unrecognizable. On the evening of the same day hake were taken in abundance. They were well fed and in fine condition; their stomachs contained *Prionotus*, *Centropristis*, *Clupea æstivalis*, *Scomber scombrus*, and the little flounder observed in the morning. The fishing bank is in north latitude 37° 43′ to 37° 45′, west longitude 74° 15′, depth 36 fathoms.

May 7, two individuals were taken in north latitude 39° 20′, west longitude 73° 09′, using menhaden for bait.

May 22, in about north latitude 39° 36′, west longitude 73° 37′, the *Grampus* tried hand-line fishing with fresh clams; two specimens of the common hake were taken. In the stomach of one of them was an unrecognizable eel-shaped or blenniform fish. These examples were females with very small ovaries.

On the same day a young example, 2 inches long, was caught at the surface in latitude 39° 45′, longitude 73° 49′.

ONOS CIMBRIUS.

Young specimens were caught in the dip-net May 12.

Again in the evening of May 12 in north latitude 38° 40′, west longitude 73° 53′, the large towing net captured a young rockling.

On May 20, in north latitude 38° 50′, west longitude 74° 06′, a great many young rockling were caught in the towing net.

CYCLOPTERUS LUMPUS.

Young specimens were caught in dip-net May 30, under floating rockweed, in Narragansett Bay.

PRIONOTUS.

April 23. Captain Rowe took in a purse seine, 30 miles off Hog Island, about 25 or 30 barrels of sea robins in company with alewives, young dog-fish, a few young *Lophius*, and three tinker mackerel. This was a most unusual and unexpected catch, the sea robins being true bottom fishes.

COTTUS OCTODECIMSPINOSUS.

May 30. About 14 miles southwest ½ west from Gay Head, we caught an 18-spined sculpin on the hand-line.

SCOMBER SCOMBRUS L.

Localities of mackerel, 1887.

April 8. Schooner *Grampus*, off Smith's Island, mouth of Chesapeake Bay, caught two mackerel with alewives. Another vessel was reported to have taken some about that time.

April 10. Captain Keene, of the schooner *Howard Holbrook*, reports having seen small schools and two large schools at night in north latitude 37° 50′, west longitude 73° 13′; these were supposed to be large school fish. The schooner *John S. McQuinn* saw fish on the same night.

About April 20, Capt. Sol. Jacobs and Captain Nauss stated that there was quite a body of fish in north latitude 37° 25′, to 37° 40′, and west longitude 74° 25′ to 74° 35′. It was observed that alewives were more or less mixed with the mackerel usually, and it was remarked by the fishermen up to the end of April that the mackerel schooled mostly at night.

April 23. Capt. Sol. Rowe caught three tinker mackerel in a purse seine, 30 miles off Hog Island, in company with *Prionotus*, *Clupea*, *Squalus* and *Lophius*.

April 27. Capt. Joseph Smith, schooner *Alice M. Center*, saw his first school of mackerel in north latitude 37° 36′, west longitude 74° 42′.

April 27 or 28. Captain McKay is said to have seen large mackerel 60 miles south of No Man's Land.

In the latter part of April, the schooner *Melissa D. Robins* saw a quantity of small mackerel in the night, about north latitude 38° 17′, west longitude 74° 15′.

May 1. Captain McGowan was in a school of mixed fish in about north latitude 36° 43′, west longitude 74° 43′, and says that the body of fish was the largest he has seen in the south in five years.

The schooner *Carrie Parsons*, on the night of May 1, saw a large mass of mackerel in north latitude 36° 47′, west longitude 74° 53′.

May 2. Captain Smith next saw the mackerel in about north latitude 37°, 50 miles east by south from Cape Charles. He followed them about 35 miles north-northeast.

May 2. Captain Fernald, schooner *Lilla B. Fernald*, caught some mackerel off Hog Island, in 17 fathoms. The schooner *Lula Wilbur* also took some.

May 3. Steamer *Vidette* from Mobile, at New York, reports in latitude 36° N. water fairly alive with schools of mackerel; mackerel fleet 50 miles north.

May 4. About this date the schooner *Edith Rowe* reports having taken 200 barrels of small mackerel 18 or 20 miles southeast from Barnegat.

May 5. The schooner *Carrie Parsons* saw a large body of fish at night in north latitude 37° 08′.

May 7. The schooner *Carrie Parsons* saw plenty of fish at night in north latitude 37° 30′, west longitude 74° 39′; 28 fathoms.

May 8. Between 8 and 9 p. m. we saw from the *Grampus* five schools of fish, one of them very large; north latitude 38° 03′, west longitude 74° 18′.

May 8. The schooner *Ralph Hodgdon*, of Gloucester, saw several schools in the morning and at night in north latitude 37° 48′, west longitude 74° 15′.

May 9. Captain Smith caught 104 barrels salt and some fresh in north latitude 37° 50′, west longitude 74° 34′. His was the northwest vessel of the fleet and alone, the fleet of thirty sail being barely visible to the southeast.

May 9. The schooner *Margaret S. Smith* reports a large body of mackerel extending from north latitude 37° 46′, west longitude 74° 15′ to Cape Henry. They were showing up well day and night for a week except May 8.

The catch of eight vessels in a fleet of twenty-one or twenty-two was all made between latitude 37° 20′ and 37° 40′; longitude 74° 28′ and 74° 50′.

May 9. The schooner *Clara S. Cameron* reported the capture of 50 barrels of large fish, not mixed with small ones. At night Captain Carroll took about 12 barrels of mixed fish, two-thirds of them between 11 and 12 inches long, the rest tinkers. Capt. Sol Jacobs also made a small haul of the same kind. At this time the water was full of "slicks." The fish were very wild, and most of the sets failed.

May 10. Captain Thomas, schooner *Maud S*, took 47 wash-barrels in north latitude 37° 07′, west longitude 74° 40′; 35 fathoms.

May 10. The gill-nets of the *Grampus*, in north latitude 38° 07′, west longitude 74° 21′, caught twenty-one mackerel and one mackerel shark. The mackerel ranged in length from 11 to 12¾ inches. Most of them were alive, and one put in the well recovered fully. All were meshed in the south side of the nets, seven in the lower part of the mackerel-net, and fourteen well up in the surface herring-net. The depth of the school may therefore have been 5 fathoms or more. None of the fish were nearer than 3 feet from the top of the net.

On this night Capt. Sol. Jacobs took a small school of 13 to 15 inch fish. He saw a number of small schools, but no large ones.

May 11. Captain Williams reported having seen several schools at night about 35 miles north-northeast of latitude 38° 34′, longitude 74° 15′.

May 11. Captain Carroll, schooner *Warren J. Crosby*, caught 75 barrels of large mackerel in the night. He says four or five other vessels caught fish in our vicinity.

May 12. The mackerel from May 3 to this date seem to be located between 37° and 38° 10′ north latitude, and 74° 28′ to 75° 25′ west longitude. Some were caught as far north as 38° 40′, west longitude 73° 52′. These were principally small and mixed, except one trip of large fish. The species was said to occupy a width of 15 miles east and west and to extend 25 or 30 miles north and south.

May 12. Schooner *M. S. Ayer*, 60 miles south-southeast from Cape Henlopen, seined 200 barrels round fish.

May 12. Schooner *Grampus* took one mackerel in gill-net at 4.35 a. m. latitude 38° 30′, longitude 73° 55′.

May 12. Captain McGowan left New York. He saw small schools off Scotland Light-Ship, which he thought were large fish. Schooner *Col. J. H. French*, coming from northward, reports a small school or two.

Captain Spurling, schooner *Lizzie Maud*, reports twenty-five sail arriving at New York since May 3. The fish were taken from 15 miles off Smith's Island, Maryland, to 50 miles off-shore, latitude of Cape Henry. Captain Chase, schooner *Clara S. Cameron*, reports the southern body of fish enormous and very wild.

May 13. In north latitude 37° 48′, west longitude 74° 13′, 37 fathoms, a fleet of eleven vessels was working on the mackerel. About sundown four vessels set for fish, but one made a water haul, while the *Henry Morganthau*, of Portland, Captain McGowan, the *Caroline Vought*, of Boothbay, and one other vessel were successful. Captain Collins and I went to the *Morganthau* to see them bail in. They had about 200 barrels of mixed fish, ranging from 11 inches to 13½ inches. She had just arrived here from New York.

May 13. Capt. Sol. Jacobs, schooner *Mollie Adams*, is reported to have caught mackerel in 12 fathoms off Winter Quarter Shoal.

Captain Chase, schooner *Clara S. Cameron*, took 127 barrels of mixed mackerel at night off Winter Quarter Shoal. He saw milt but no eggs, and thought there were no females.

May 13. Eight schools, mostly large ones, were seen from the *Grampus* at 7 p. m. A vessel near us caught a small school. The watch saw several more schools in the night. The location was latitude 37° 48′ N. and longitude 74° 13′ W.; 37 fathoms.

May 13. Captain Smith left New York and saw no fishermen except Captain Joyce, who seemed to be going to market. He saw no fish on the way south.

May 13. The schooner *William M. Gaffney* has just come from the northward. She cruised all the way from 15 miles off Fire Island and saw no fish. Our position was about north latitude 37° 48′, west longitude 74° 13′.

May 14. The schooner *John G. Whittier* came out of New York and sailed to the southward, keeping close in shore. She saw no fish.

May 15. Between 8.30 and 9.30 p. m. (38° 41′ to 38° 51′ north latitude, 74° 16′ to 74° 09′ west longitude, 21 to 22 fathoms), *Grampus* saw eight or nine schools, some very large. At 9.45 a school about twice as long as the vessel was along-side. Between 11 and 12 p. m., twenty-four schools were seen. Between 12 and 2, five more were seen. All appeared to be working to northeast, some of them fast. The fish were only about 12 miles southeast of the southern light ship (Five Fathom Bank), and we sailed through them for 10 miles.

May 15. Six vessels joined the *M. S. Ayer* in Philadelphia, each of them having 200 barrels or more.

Schooner *Grampus* saw multitudes of mackerel, alewives, etc., mixed, in north latitude 38° 41′ to 38° 51′, west longitude 74° 16′ to 74° 09′, 21 or 22 fathoms. The schooners *Edward E. Webster* and *Warren J. Croxby* were seen taking mackerel.

May 17. Schooner *John G. Whittier* took 10 or 12 barrels of mackerel, mixed with alewives in excess, off Five Fathom Shoal. Schooner *Hattie L. Newman* caught some mackerel, with abundant alewives, in the same locality.

May 18. Captain Wilcox, steamer *Alaska*, seined 2 barrels of large mackerel off Shinnecock in 12 fathoms.

Captain Cromwell, schooner *Hattie Evelyn*, saw a large body of fish about in north latitude 39° 21′, west longitude 73° 39′, showing day and night and traveling north-northeast.

May 19. Schooner *Grampus* saw numerous schools of fish from 6 to 8 miles west-southwest from southern light-ship on Five Fathom Bank, and many more at night not far from this locality. These were supposed to be menhaden.

May 19. Captain Cromwell reports the fish working fast east-northeast to east-southeast.

May 19 or 20. Schooner *Margaret S. Smith* took good mackerel north by east from the southern light-ship on Five Fathom Bank.

May 20. Schooner *Carrie E. Parsons* reports plenty of mackerel 30 miles southeast from Barnegat.

Captain Cromwell was in about 39° 56′ north latitude, 72° 46′ west longitude, 40 fathoms. The fish worked southeast; eleven or twelve vessels were among them. After that they lost them.

Captain Harty, schooner *Israel J. Merritt*, caught 189 barrels off Barnegat.

May 21. Numerous schools of fish were seen during the night from the *Grampus*. These were said to be mackerel and alewives. This was about in north latitude 39° 40′, west longitude 73° 38′.

May 21. Captain Harty took 125 barrels 25 miles southeast of Sandy Hook light-ship. They were from 11 to 13 inches long, and a large body of fish was in that vicinity.

May 21. Plenty of fish are reported by pilot-boat No. 6 southeast of Barnegat, the light just awash.

Captain Wilcox, steamer *Alaska*, took 73 macl [illegible] f Neapeague, Long Island, near shore.

May 22. Captain Greenleaf was told by a coaster that there were plenty of fish south-southeast from Fire Island during the night. He could not tell what they were, but it was supposed that some of them were mackerel.

May 22. The schooner *Carrie E. Parsons* reports having seen plenty of fish during the night about north latitude 40° 09′, west longitude 73° 23′.

May 23. Captain Greenleaf cruised recently as far south as Cape Henry and saw no fish.

Schooner *Joe Hooker* saw mackerel in the morning in north latitude 40° 17′, west longitude 73° 10′. The fish were going northeast.

Captain Chase, schooner *Clara S. Cameron*, saw a few small schools at night 13 miles south-southeast from Montauk. Fishing was prevented by starlight.

Schooners *William H. Foye* and *Grover Cleveland* saw three schools 12 miles south-southwest from False Montauk.

May 23. Captain Chase reports having seen during the night large bodies of fish deep in the water 45 miles southwest ½ south from Shinnecock.

May 24. Schooner *William H. Foye* has cruised recently about Block Island and saw no mackerel.

May 26. Schooner *Mary H. Thomas* caught in the day-time 35 barrels of mackerel with alewives, 18 miles southeast from Block Island; also 25 barrels of mackerel with 100 barrels of alewives. In length the fish were from 11 to 14 inches; those of 14 inches were few, but many were 13 inches. The fish were going south-southeast slowly.

May 27. Captain Decker, schooner *Robert J. Edwards*, took 50 barrels 15 miles southeast from Block Island in the afternoon. He observed particularly that no eggs were present, but some large sexually developed males were captured.

Schooner *Elsie Smith* seined 50 barrels 15 miles south-southeast from Block Island; 18 vessels were present; 12 took fish.

May 27. Capt. John Whitmore, schooner *Fannie Spurling*, at 2 p. m. saw a large body of fish "just shadowing" 15 miles southeast by south from Block Island; they "came up good" at 5 p. m. From 2 to 5 p. m. they went about 5 miles northeast. He reports 12 sail getting fish. The fleet was scattered over 3 or 4 miles in extent.

Captain Harty, 40 miles southeast ½ east from Block Island, saw about 12 small schools at night. Weather prevented setting.

May 30. Schooner *Grampus* was in north latitude 41° 12′, west longitude 71° 09′. Plenty of mackerel mixed with alewives were showing well in the afternoon. Some vessels are getting them a few miles southwest of us. Two men from a dory threw bait directly into the schools, feeding with their heads out; the fish turned, but refused to jig. We saw 12 or 15 schools of large Block Island mackerel which were not mixed with alewives.

West-southwest and southwest from No Man's Land, 6 to 8 miles, we saw many "pods" and some moderately large schools. One school, about 5.15 p. m., was "cart-wheeling."

At 7.30 p. m. twenty-odd sail are working on mackerel about 10 or 12 miles west-southwest from No Man's Land. Many boats are out.

Size of mackerel.

As a rule the mackerel taken during April were principally tinkers. Most of the fish that we saw ranged from about 11 to 13 inches. Mixed mackerel were the rule.

Miscellaneous notes.

In the early days of seining it is stated that the mackerel never dived under the seine; now they do it only too often. I was informed that Captain Jacobs once made thirty-two consecutive water-hauls and was successful with the thirty-third set. In setting the seine they aim to get the heads of the fish; that is, the advance part of the school, and not the tails.

It is stated that poor fish hang down in the seine much harder than fat ones.

Captain Warren, schooner *Alice C. Jordan*, told Capt. D. E. Collins that on February 10, 1887, he saw about a half barrel of mackerel 10 or 12 inches long, and very poor, taken in a seine with herring in English Harbor, Fortune Bay, Newfoundland.

It has been generally remarked by the fishermen that mackerel have been hard to seine this year. They have been noted for their deep diving and sudden disappearances.

In the latter part of May it was sometimes difficult to dispose of the fresh mackerel even in New York. One captain said that he had difficulty of that kind. It is stated also that the schooner *Warren J. Crosby* carried fish to Philadelphia and had to split them.

James Rogerson, cook of the *Alice S. Hawkes*, states that large quantities of small mackerel were taken in weirs at West Quoddy, Me., in July, 1886, and carried to Eastport.

Captain Fernald was told by a lobsterman at Seal Cove, Mount Desert, Me., that he saw a great mass of mackerel standing on their heads on the bottom, the bodies canted a little.

Captain Fry saw a large spawn in a big Block Island mackerel about the end of November, 1886. He examined it carefully.

Captain Fernald saw lots of large fish about September 1, 1886, about Seal Island and Duck Island, Maine, and only one vessel near. They seemed very tame, but he could not catch any.

Food of mackerel.

May 13, in north latitude 37° 48′, west longitude 74° 13′, 37 fathoms, stomachs of mackerel obtained from the schooner *Henry Morganthau*, of Portland, were gorged with minute phosphorescent entomostraca, resembling those taken by us with towing-nets in the same locality.

A separate account of the invertebrates taken by the *Grampus* has been prepared by Mr. Richard Rathbun and others, to whom the collections were referred.

Reproduction.

Among the fish taken by the schooner *Henry Morganthau*, May 13, in north latitude 37° 48′, west longitude 74° 13′, 37 fathoms, I noticed at least one well-developed male, and some ovaries of females containing eggs, which were apparently almost mature. These fish have been schooling daily in the day-time.

Failure of toll-bait.

Toll-bait was tried in all waters traversed by the *Grampus*, but always without capturing a single mackerel.

SCOMBER PNEUMATOPHORUS.

Capt. Thomas Steelman, of the steamer *Nellie O. Rawson*, and Captain Valliant, reported the occurrence of mackerel 7 to 8 inches long in abundance about the middle of August, 1886, from Hereford Inlet to Barnegat. Capt. Sol. Jacobs informed us of the report by coasters that some schools of mackerel were off Fenwick's Island in August, 1886, and they say they caught a few of the fish.

The schooner *M. S. Ayer* was informed that mackerel, some of which weighed 1½ pounds, were caught during the summer of 1886 off Atlantic City, N. J., and sold by boat fishermen to the hotels. Inquiry made from a dealer in Atlantic City furnished a corroboration of this statement.

Capt. Henry C. Fish informed us that he saw, about September 1, 1886, four or five very large schools (a thousand barrels) of "Bull-eyed" mackerel 7 or 8 inches long. One of the steamers caught some, but he did not. The locality must have been off the south shore of Long Island.

June 28.—Brig *H. B. Hussey* reports, June 28, Five Fathom Bank light-ship bearing west by north 50 miles, saw small school of mackerel. These were probably *S. pneumatophorus.*

Willard Nye, jr., was informed by a fisherman at Yarmouth, Nova Scotia, that the first chub mackerel caught there he caught in September, 1886. During that year about a dozen were reported in that vicinity. In 1887, up to August 15, they were plentiful. Two men, fishing from a boat for the ordinary mackerel, caught a dozen a day.

At Halifax, Nova Scotia, in 1887, the fishermen had not seen any of the chub mackerel.

PORONOTUS TRIACANTHUS.

April 13. One large specimen was caught in a gill-net in latitude 37° 29′, longitude 75° 12′.

April 25. A young example was taken in the towing-net.

April 26. One young individual was secured in latitude 37° 36′, longitude 74° 28′.

Young specimens were caught in the dip-net May 12.

Young examples were obtained in the towing-net May 6, in north latitude 38° 43′, west longitude 73° 48′.

In the evening of May 12 four small individuals were taken in the towing-net in north latitude 38° 40′, west longitude 73° 53′.

POMATOMUS SALTATRIX.

On the evening of May 12, in north latitude 38° 40′, west longitude 73° 53′, a bluefish 1¼ inches long was captured in the towing-net. This is one of the very few young bluefish so far obtained in our waters.

TYLOSURUS MARINUS.

April 30. Capt. Scott Rackliff, of the schooner *Volunteer*, sent to the *Grampus* a billfish, which he had caught in his seine off Chesapeake Bay.

BREVOORTIA TYRANNUS.

April 21. In the harbor of Fortress Monroe we heard the "flip" of the menhaden frequently.

May 10 or 11. Captain Williams reported enormous quantities in New York Bay, inside the Hook and in the vicinity of Sandy Hook.

May 12. Capt. Henry C. Fish, steamer *Vesta*, reports first capture, this date, off Barnegat.

May 16. Capt. Henry C. Fish says menhaden were caught off Shinnecock, same date as in 1886.

May 16. Several menhaden steamers are lying at Delaware Breakwater. Dead menhaden were floating out with the tide from the breakwater as the *Grampus* entered.

May 17. Capt. Thomas Steelman, steamer *Nellie E. Rawson*, reported the capture May 16, of 10,000 menhaden, the first of the season. They are fifteen days later than usual; last year at this date the fishing was good. A body of menhaden went past Cape Henlopen May 2 and 3.

May 19. Schooner *M. S. Ayer* reports seeing plenty of menhaden at night, not far from north latitude 38° 42′, west longitude 74° 21′.

May 20. Schooner *Grampus* at night saw schools which were supposed, from their movements, to be menhaden. The position was not far from latitude 38° 46′, longitude 74° 12′.

Captain Jones, schooner *Alice S. Hawkes*, saw large bodies off Absecon, from 5 to 20 miles off-shore.

May 25. Capt. Henry C. Fish says there seems to be a large but scattered body of menhaden off Montauk. He thinks there is a larger body yet to come.

May 25. Mackerel fishermen report large bodies of menhaden 40 miles southeast from Montauk. They show in Long Island Sound about the middle of June, and range eastward to Nantucket and Buzzard's Bay.

May 29. Menhaden steamers belonging in the vicinity of the eastern end of Long Island are engaged in fishing in its waters.

CLUPEA VERNALIS AND ÆSTIVALIS.

As early as April 23 Capt. Sol. Rowe seined some alewives about 30 miles off Hog Island. In company with them, at the surface, he caught 25 or 30 barrels of sea robins (*Prionotus* sp.), young dogfish (*Squalus acanthias*), a few young goose-fish (*Lophius piscatorius*), and three tinker mackerel.

May 22 the schooner *Grampus* took in gill-nets four specimens of *Clupea vernalis*, one female and three males. The female was about 10 inches long and larger than any of the males. The ovaries and spermaries were very small, showing that these are probably young fish and not yet ready to leave the sea, although full grown, or nearly so. The locality is about north latitude 39° 40′, west longitude 73° 38′.

On the night of May 22 the schooner *Porter Roberts* set in about north latitude 40°, west longitude 73° 28′, and got alewives.

May 26. Captain Decker, schooner *Robert J. Edwards*, went out from Sandy Hook in company with 20 fishermen. He sailed east ½ south from Sandy Hook. At a distance of 50 miles he saw large bodies of alewives. He caught about a bushel of them. In dressing them no eggs or milt were noticed, from which it is probable that these were young fish. They were going northward about 7 miles per hour.

May 28. The schooner *Mary H. Thomas* caught alewives with mackerel, 18 miles southeast from Block Island; she took 25 barrels at one set and 100 barrels at another time.

May 30. The schooner *Grampus* saw numerous schools of alewives mixed with mackerel 17 miles southeast ½ south from Brenton's Reef light-ship, or north latitude 41° 12′, west longitude 71° 09′. The fish were showing well in the afternoon.

RAIA LÆVIS.

April 27. Specimens were caught on hand-lines in north latitude 37° 43′, west longitude 74° 15′, 36 fathoms.

May 7. Two females were caught on hand-lines from the *Grampus*, menhaden for bait, in about north latitude 39° 20′, west longitude 73°

09′. They were feeding on hermit crabs and a gastropod resembling *Natica*.

May 8. In the afternoon the *Grampus* took a female of this skate on a hand-line. In its stomach were numerous hermit crabs of good size. The shells of the crabs were not present, except a single small one.

May 9. Males of this species were taken from the *Grampus* on hand-lines in about 37° 46′ north latitude, 74° 15′ west longitude.

In the afternoon of May 9, in about north latitude 38° 03′, west longitude 74° 10′, we took barn-door skates of both sexes and found crabs in their stomachs.

SQUALUS ACANTHIAS.

April 23. Young examples were taken in a purse seine by Capt. Sol Rowe 30 miles off Hog Island in company with *Prionotus*, *Clupea*, *Lophius*, and *Scomber*.

April 24. Five dogfish were caught on hand-lines; their stomachs were empty. One female contained young 6 inches long. When the young were dropped into a pail of water they tried to swim. Opening the abdomen of a dogfish does not prevent it from swimming off into and under the water at a rapid rate.

April 26. In the evening dogfish were taken on hand-lines.

April 27. Many examples, principally females, were brought up on lines in north latitude 37° 43′, west longitude 74° 15′. One male had on his livery of numerous large milk-white spots. The females had no large spots, but a few small ones. The green eye of this species is remarkable.

May 7. The *Grampus* caught several dogfish, all of which were females but one, in about north latitude 39° 20′, west longitude 73° 09′, and on May 8 two females were taken in north latitude 38° 25′, west longitude 74° 06′, 28 fathoms.

May 9. In about north latitude 37° 46′, west longitude 74° 15′, dogfish were taken from the *Grampus* on hand lines.

May 11. In about north latitude 38° 11′, west longitude 74° 23′, from 23 fathoms the *Grampus* took several dogfish with fresh mackerel for bait. Several fish at a time would follow the hook up to the surface.

Very early in the morning of May 12 about a dozen dogfish measuring 15 inches or so in length were taken from the gill-nets of the *Grampus*. Later in the same day in about north latitude 38° 30′, west longitude 74° 02′, additional specimens were taken on hand-lines.

During the afternoon of the same day in about north latitude 38° 03′, west longitude 74° 10′, we took dogfish, mostly females, and found in their stomachs *Prionotus*.

May 12. During the evening, which was remarkably fine with a smooth sea, swarms of dogfish were seen at the surface, their dorsal fins showing out of water. They were generally in pairs. Capt. J. W. Collins told me that he has seen myriads of them on the fishing banks in summer. We tried hand-lines, but even the dogfish were off the bottom and we caught nothing. The dogfish near the surface amused themselves and us by trying to steal the bait from our hooks without taking the hook in their mouths. One of the men held a line alongside among the dogfish. A very shrewd youngster came up and bit at the shank of the hook as if to try its quality; then he carefully took between his teeth one edge of the bait as far as possible from the point of the hook, and shook his head like a dog to free the morsel, and he escaped with it.

This habit of swimming with the dorsal out of water is called "finning." Captain Collins has seen it in June on Brown's Bank, the fish extending as far as the eye could reach on moderate evenings; some of the men of the *Grampus* have seen the "finning" all through the moderate summer evenings on the New England fishing banks.

LAMNA CORNUBICA.

May 10. The gill-nets of the *Grampus* were hauled and contained twenty-one mackerel, while rolled up in the eastern end of the herring net we found a mackerel shark 67 inches long. In its stomach were the remains of six *Prionotus* and four small *Squalus*. I found a few parasites, most of them on the edges of the caudal lobes. The location of this haul was in about north latitude 38° 07′, west longitude 74° 21′.

FISH EGGS.

May 19. In the evening, not far from the southern light ship on Five-fathom Bank, the *Grampus* took many floating eggs in the towing net.

May 20. In latitude 38° 42′, longitude 74° 21′ a few floating eggs were taken in the towing net.

May 26. Floating eggs similar to those found near Five-fathom Bank Southern Light-ship, May 19, were caught with the towing net in the eastern end of Long Island Sound early in the morning. The oil globule was very noticeable in these eggs.

May 30. Two species of floating eggs were found abundant in Narragansett Bay, differing in size and development. Two ribbons of *Lophius* eggs were seen. The envelope of the egg mass was so tough and tenacious that we were obliged to cut it with a knife. The eggs are in honeycomb-like cells.

FISH TRAPS.

May 26. Some of the fishes caught in the fish traps about the eastern end of Long Island about this date are: *Tetrodon turgidus*, *Prionotus palmipes*, *Stenotomus chrysops*, *Centropristis furcus*, and *Brevoortia tyrannus*.

FISHERMEN'S VERNACULAR.

Characteristics of fishes: "Slap" of menhaden, "raining or pattering" of herring; "Chug" of mackerel. Alewives, and menhaden settle when alarmed; mackerel dart away; "mulling" of herring and menhaden means gradual settling.

A small bunch of fish is a "small pod"; a "dory pod" contains about enough fish to fill a dory. A "red school" is one which lies under a mass of red entomostraca, etc., forming its food. "Butts," the heads of a school, or of fish. "Red birds" or "sea geese" are red phalaropes. Tails schooling and heads settled means that the advance fish have been alarmed and sunk while the rear end of the school is still schooling. "Swinging" of a school is cart-wheeling. "Soaking to windward" is moving slowly against the wind.

Speaking of an unsuccessful set of the seine for a school of fish a captain said, "I set at it but didn't stop nothin'."

Another expression of a captain who saw a chronometer on the *Grampus* for the first time was, "I never was shipmates with a chronometer before."

Another captain, who thrust a board with all his strength to a drowning man, said, "I pooned a board at him."

CETACEANS.

The cruise was remarkable for the scarcity of cetaceans. Puffing-pigs were seen at Fortress Monroe, Delaware Bay, and near Montauk. A few blackfish were seen on May 1. I observed among them what appeared to be an *Orca*, but they were too far off to be identified.

On the 11th of May a moderately large-sized school of porpoises was seen coming from the southward in about north latitude 38° 11′, west longitude 74° 23′.

On the evening of May 14 a school of about thirty *Delphinus* was alongside, and near night a few more were seen. This was in north latitude 38° 03′, west longitude 74° 12′.

On May 15 Captain Fernald caught a *Delphinus* containing a fœtus 22 or 23 inches long, which was removed alive and seemed almost viable.

Early in the morning of May 24 a school of porpoises was seen off the south side of Long Island.

On May 24 also a small whale was reported by one of the men of the *Grampus* near Montauk.

May 27, 40 miles southeast ½ east from Block Island, Captain Harty reported whales plentiful.

BIRDS.

We were struck by the remarkable scarcity of birds during our entire cruise from Fortress Monroe to Cape Cod. The species which are usually recognized as the associates of the mackerel were generally scarce; gannets were never plentiful, and "sea-geese" (red phalaropes) usually were only in small bunches and widely scattered. It was remarked by the fishermen that the mackerel and the birds remained unusually long in the southern waters south of Cape Henry.

On the 12th of May Captain Chase told us that birds were so abundant with the southern body of fish as to interfere with seining. On the 21st of April, in the harbor of Fortress Monroe, we found the usual abundance of ducks; gulls, terns, and kittiwakes were also present; cormorants, loons, and grebes were occasionally seen. Coots had not yet left those waters.

On the 5th of May coots were flying to the southward in Delaware Bay. On the 16th of May, when we returned to the breakwater, no coots were seen. On the 16th, two small flocks of coots were seen flying southward in the eastern end of Long Island Sound. A large flock was observed near Brenton's Reef light-ship, also flying southward.

In the evening of May 13, in about north latitude 37° 48′, west longitude 74° 13′, we saw a flock of phalaropes.

In the evening of May 20, in about north latitude 38° 42′, west longitude 74° 21′, a small flock of phalaropes was observed, and on the 26th of May we saw a flock of the same birds near Montauk.

In the evening of May 9 three jægers were tolled up with liver, but not close enough to be shot. Two of these birds were near us on May 29, but the sea was too rough to attempt their capture.

Petrels, Cary chickens, called "sailors' ghosts" by the fishermen, were seen everywhere, and could frequently be brought up alongside by the use of fish-chum close enough to be caught with dip-nets.

Land birds were occasionally noticed at sea. A chestnut-crowned sparrow came aboard on the morning of April 29 when we were probably 50 miles offshore, and a small hawk was alongside on the same evening. On the 9th of May, when we were 49 miles offshore, a red-headed woodpecker flew on board the *Grampus*.

May 27, 40 miles southeast ½ east from Block Island, Captain Harty reported birds plentiful.

Bird feathers.

At 8.30 p. m. May 23, in north latitude 40° 19′ west longitude 73° 06′, some floating feathers were obtained in the towing-net. These are considered by fishermen to indicate the presence of fish in the direction from which the feathers come.

NOTICE OF THE SMALL SURFACE ORGANISMS TAKEN IN THE TOW-NETS, AND OF THE CONTENTS OF MACKEREL STOMACHS, BY RICHARD RATHBUN.

The number of lots of towings handed to me for examination was 36. Some of these were obtained by means of a large conical net, of rather coarse mesh, intended principally for the capture of fish, and in which never more then a trifling quantity of the smaller animals was retained; the larger number were taken in the ordinary pattern of tow-net, made of silk bolting-cloth, and measuring 12 inches across at the mouth and about 22 inches deep; a few were secured with a dip-net. They were all taken at the surface between April 25 and May 30, 1887. The positions have been described elsewhere by Dr. Bean, and are also given below, in connection with the list of species obtained at each locality.

The best results, as regards the smaller animals, were obtained with the 12-inch tow-net, and although the distance actually traversed by the net each time that it was used was not determined, yet we have been able to form some idea of the relative abundance of life in a given area at the surface during the beginning of the mackerel season. The usual length of a towing was from one-half hour to one hour, the vessel sailing at the rate of 2 or 3 knots an hour. The quantity of material from each towing was calculated by liquid measure, the specimens first being allowed to settle thoroughly in the bottle containing them. While this method did not afford absolute results, by measuring the contents of the mackerel stomachs in the same manner a comparison of the two was rendered possible.

The quantity of specimens in each lot of towings was from 1 to 20 drams. One towing, affording 18 drams, was made in 15 minutes May 9, beginning at 8.15 p. m. The 25 towings with the 12-inch net resulted in a total catch of 115 drams of specimens, or an average of 4⅗ drams to a towing.

The contents of the stomachs of mackerel were preserved on two days only, May 10 and May 13. The size of the fish was from 11 to 13½ inches in length. On the first day mentioned the quantity of food taken from the stomachs averaged 4 drams to a stomach; on the second day it averaged 5¼ drams, except in the case of one specimen, which afforded 8 drams. The average quantity of food to a stomach, therefore, agreed very closely with the average results of a towing with the 12-inch net.

These deductions, however, are based upon too few observations to have any special significance. It is well known that the surface organisms serving as food for mackerel and other pelagic fishes are very unequally distributed, and are constantly changing their position, appearing and reappearing under the varying conditions of the water and atmosphere. While sometimes they are apparently absent over wide areas, at others they form dense clouds, plainly distinguishable by their color. Such swarms would readily attract the schools of rapidly swimming fishes, while they might easily escape the notice of a fishing-vessel moving slowly from place to place. It is also probable, from previous observations of the Fish Commission, that the mackerel feeds to some extent below the surface.

As to the character of its food the mackerel probably exercises little discrimination, but swallows all the smaller objects occurring in its path. Certain species or groups of species are, however, much more abundant than others, and these are recognized as its common or appropriate food. Such are the copepods, the pelagic amphipods, some of the pteropods, and perhaps *Sagitta*. On the present cruise several species of copepods, *Themisto bispinosa* of amphipods, *Spirialis*, sp. of pteropods, and *Sagitta elegans* were the most common and wide-spread, and they were all abundant in the stomachs examined.

A list of the forms identified from the towings and an account of the contents of each towing are given below. In the hasty examination made, many species have undoubtedly escaped notice, and the lists should be regarded as containing only the more common or more conspicuous forms. But few jelly-fishes, representing only two genera and species of small size, were preserved, though other forms were taken by the schooner. *Sagitta* was often very abundant, but annelids were exceedingly rare, and not more than three or four species were observed. Of copepods *Temora longicaudata* was identified from most of the towings; *Calanus*, sp., was nearly as wide-spread, and often more abundant; *Centropages typicus* was very common; *Pleuromma*, sp., composed the bulk of one of the towings, and two of the smaller lots consisted almost exclusively of *Anomalocera Patersonii. Themisto bispinosa*, of amphipods, was nearly always present, and sometimes in great abundance, though often young and small; *Calliopius læviusculus* occurred only in Fort Pond Bay, Long Island, and Narragansett Bay. Isopods were rare and represented by only one genus, *Idotea*, of which three species were taken, one, however, only in Narragansett Bay. The Schizopoda and Decapoda were represented by young stages only. Of pteropods, *Clione limacina* was moderately abundant at times, while *Spirialis* was often very common, in some cases composing a large proportion of the bulk of the towing. *Salpa Caboti* occurred only in one instance. The eggs and embryos of fishes were sometimes abundant, but there was seldom any trace of vegetable life, except in the rare occurrence of small decayed fragments, apparently of eel grass, *Zostera*. An interesting feature was the finding of so many species of insects blown or drifted from the shore. Seventeen species belonging to four orders were taken, but each species was represented by only one to four specimens.

Prof. S. I. Smith kindly examined the amphipods, schizopods, cumacea and decapods, and has furnished such identifications as are given. Mr. J. Walter Fewkes has determined the Medusæ, Mr. William H. Dall the Mollusca, and Mr. John B. Smith the insects.

LIST OF THE FORMS IDENTIFIED FROM THE TOWINGS.

CŒLENTERATA.

HYDROMEDUSÆ.

Trachynema digitale A. Agassiz.

CTENOPHORA.

Pleurobrachia rhododactyla Agassiz.

WORMS.

CHÆTOGNATHA.

Sagitta, sp., probably *Sagitta elegans* Verrill.

CHÆTOPODA.

Tomopteris, sp., and two or three other undetermined forms.

CRUSTACEA.

OSTRACODA.

One undetermined species.

COPEPODA.

Calanus. (Two or more species which have not been identified.)
Pleuromma, sp.
Temora longicaudata Lubbock.
Centropages typicus Kröyer.
Centropages hamatus Lilljeborg.
Anomalocera Patersonii Templeton.
Candace pectinata Brady.

AMPHIPODA.

Themisto bispinosa Bœck.

Calliopius læviusculus Bœck. (From Fort Pond Bay, Long Island, and Narragansett Bay.)

ISOPODA.

Idotea irrorata Edwards.
Idotea robusta Kröyer.
Idotea phosphorea Harger. (From Narragansett Bay.)

CUMACEA.

The young of one undetermined species, represented by a single specimen.

SCHIZOPODA.

Nyctiphanes norvegica G. O. Sars (?), young; also the very young of one or more undetermined species.

DECAPODA.

Larval Macrurans, Anomurans, and Brachyurans.

MOLLUSCA.

HETEROPODA.

Firola, sp.

PTEROPODA.

Clione limacina Phipps.

Spirialis. (Represented by at least two species, one with a tall, the other with a short spire; the latter is the more common.)

TUNICATA.

Salpa Cabotii Desor.

INSECTA.

COLEOPTERA.

Bradycellus rupestris Say. 2 specimens.
Psyllobora 20-maculata Say. 1 specimen.

DIPTERA.

Limnophila ? 2 species; each 1 specimen.
Goniomyia ? 2 species; each 1 specimen.
Erioptera ? 1 species; 1 specimen.
Geranomyia. 1 species; 1 specimen.
Eristalis transversus Wied. 1 specimen.
Nemotelus, sp. 1 specimen.
Anthomyia, sp. 4 specimens.
Drosophila, sp. 1 specimen.
Muscid. 1 sp. Loc. uncertain. 1 specimen.

HEMIPTERA. (HETEROPTERA.)

Euschistus variolaris Beauv. 1 specimen.

HEMIPTERA. (HOMOPTERA.)

Siphonophora, sp. 3 specimens.

ARANEA.

Misumena americana Keys. 2 specimens.
Epeira labyrintha Hentz (young). 1 specimen.

DESCRIPTIONS OF THE CONTENTS OF THE TOWINGS, ARRANGED CHRONOLOGICALLY.

April 25, 6 a. m. (lat. 37° 36′ N., long. 74° 28′ W.); large net. Contained about 25 specimens of *Themisto bispinosa*, 2 specimens of *Clione limacina*, and about 15 specimens of *Spirialis*, sp.

April 27, 6 to 7 a. m. (lat. 37° 43′ N., long. 74° 15′ W.); large net. Contained about 20 specimens of *Themisto bispinosa*, and 1 each of *Nyctiphanes norvegica* (?), young, and *Pleurobrachia rhododactyla*.

April 27, 8 a. m. (lat. 37° 43′ N., long. 74° 15′ W.); small net; quantity 5 drams. Consisted almost entirely of *Calanus*, sp., with *Centropages hamatus*, abundant, and the following very rare: *Themisto bispinosa*, *Sagitta*, *Clione limacina*.

April 27, 2.35 to 3 p. m. (lat. 37° 43′ N., long. 74° 15′ W.); small net; quantity 5 drams. The bulk consisted of *Calanus*, sp., and *Centropages typicus*, with a few other species of copepods in small numbers. *Sagitta* and *Clione limacina* were abundant, and the following rare: *Themisto bispinosa*, *Trachynema digitale*, and fish eggs.

April 27, about 6 p. m. (lat. 37° 45′ N., long. 74° 15′ W.); large net. The following were represented by from 1 to a few specimens each: fish eggs, *Nyctiphanes norvegica* (?), young, *Themisto bispinosa*, *Candace pectinata*, *Sagitta*, *Clione limacina*, *Salpa Cabotii*.

April 28 (lat. 37° 40′ N., long. 74° 13′ W.); small net; quantity 2½ drams. Consisted almost entirely of the following copepods: *Calanus*, sp., *Centropages hamatus*, and *Temora longicaudata*. There were also a few fish eggs, an abundance of a filamentous diatom, and a single specimen of *Trachynema digitale*.

April 29 (lat. 37° 42′ N., long. 73° 53′ W.); small net; quantity 2 drams. Consisted mostly of the following copepods: *Calanus*, sp., *Temora longicaudata*, and *Centropages hamatus*. *Themisto bispinosa*, young, and *Sagitta* also occurred sparingly.

April 30, 7 p. m. (lat. 38° 12′ N., long. 74° 26′ W.); large net. Contained a quantity of *Themisto bispinosa* and *Firola*, sp., with *Trachynema digitale*.

May 1, 6.15 to 7 p. m. (lat. 37° 36′ N., long. 74° 31′ W.); large net. Contained about a dozen specimens each of *Themisto bispinosa* and *Clione limacina*.

May 2 (lat. 38° 25′ N., long. 74° 50′ W.); small net; quantity 1 dram. Consisted mostly of *Temora longicaudata*, with *Calanus*, sp., and *Centropages typicus*. Fish eggs were also abundant.

May 6 (lat. 38° 43′ N., long. 73° 48′ W.); large net. Contained from one to a few specimens each of the following forms: *Temora longicaudata*, zoeæ of crabs, *Themisto bispinosa*, and *Pleurobrachia rhododactyla*.

May 6 (lat. 38° 43′ N., long. 73° 48′ W.); small net; quantity 6 drams. Consisted mostly of *Calanus*, sp., with *Temora longicaudata* very abundant, and *Centropages typicus* and *Spirialis*, sp., common.

May 6 (lat. 38° 19′ N., long. 74° 21′ W.); small net; quantity 6 drams.

Consisted almost exclusively of the following species of copepods: *Calanus*, sp., *Temora longicaudata* and *Centropages hamatus*, with a few *Sagittas*.

May 9, 8.15 p. m. (lat. 38° 10′ N., long. 74° 16′ W.); small net; quantity 18 drams. The net was out only fifteen minutes, and the bulk of the catch consisted apparently of one species of copepod, *Temora longicaudata*. *Themisto bispinosa*, young, and *Sagitta* were also abundant.

May 10 (lat. 38° 06′ N., long. 74° 13′ W.); small net; quantity 5½ drams. The bulk consisted of copepods, principally *Temora longicaudata*, with *Calanus*, sp., and *Centropages typicus*, both common, and *Anomalocera Patersonii* rare. A few specimens of *Sagitta*, *Spirialis*, sp., and fish eggs, and one specimen of *Pleurobrachia rhododactyla* also occurred.

May 10 (lat. about 38° 11′ N., long. about 74° 12′ W.); small net; quantity 2 drams. Composed almost entirely of *Temora longicaudata*, with some specimens of *Centropages typicus*, *Calanus*, sp., and *Anomalocera Patersonii*.

May 10 (lat. about 38° 11′ N., long. about 74° 12′); large net. Contained 1 to 3 specimens each of *Themisto bispinosa*, *Idotea irrorata*, and *Pleurobrachia rhododactyla*.

May 11 (lat. 38° 11′ N., long. 74° 23′ W.); small net; quantity 1 dram. Contained the following species: *Temora longicaudata*, *Centropages typicus*, *Calanus*, sp., *Sagitta*, *Spirialis*, sp.

May 12 (lat. 38° 30′ N., long. 74° 02′ W.); small net; quantity 3 drams. The bulk consisted of *Spirialis*, sp., and the following species of copepods: *Calanus*, sp., *Centropages typicus*, *Temora longicaudata*, and *Anomalocera Patersonii*. *Sagitta* was common; *Nyctiphanes norvegica* (?), young, moderately abundant, and *Clione limacina*, *Pleurobrachia rhododactyla*, and fish eggs, few. The following insects were also taken: *Bradycellus rupestris*, 2 specimens; *Goniomyia* (?), sp., one specimen, and a specimen of an undetermined Muscid.

May 12, 7 p. m. (lat. 38° 40′ N., long. 73° 53′ W.); small net; quantity 6 drams. Consisted mostly of small crustaceans and *Spirialis*, sp. *Calanus*, sp., very abundant; larval crustaceans and *Sagitta* very common; *Anomalocera Patersonii*, *Candace pectinata*, and *Temora longicaudata* common; *Themisto bispinosa*, young, few; *Idotea robusta*, four. The contents of this towing was labeled as the "Cayenne," of the fishermen, probably referring to the red color of the species of Calanus.

May 12 (lat. 38° 40′ N., long. 73° 53′ W.); dip-net; quantity 2 drams. The bulk consisted of *Nyctiphanes norvegica* (?), young, with very little else, the following, however, being represented: *Anomalocera Patersonii*, *Centropages typicus*, *Calanus*, sp., *Themisto bispinosa*, young, *Clione limacina*, and two specimens representing two species of insects, *Euschistus variolaris* and *Limnophila*, (?) sp.

May 13 (lat. 37° 48′ N., long. 74° 13′ W.); small net; quantity 4 drams. Consisted mainly of copepods and *Spirialis*, sp. *Centropages typicus* appears to be the most abundant of the copepods, with *Calanus*, sp., and *Pleuromma*, sp., common. *Clione limacina* and decapod larvæ were also common.

May 14, evening (lat. 38° 03′ N., long. 74° 12′ W.); small net, quantity 4 drams. The bulk consisted of *Themisto bispinosa*, and of copepods, of which *Calanus*, sp., seemed to be the most abundant, with *Centropages typicus* nearly as common, and *Candace pectinata*, rare. *Sagitta* and *Spirialis*, sp., were also very abundant, and larval decapods, *Clione limacina* and *Pleurobrachia rhododactyla*, all common.

May 15, 7.30 p. m. (lat. 38° 39′ N., long. 74° 03′ W.); small net, quantity 2 drams. Consisted mainly of the following copepods: *Calanus*, sp., *Centropages typicus*, *Temora longicaudata* and *Pleuromma*, sp., with *Anomalocera Patersonii*, rare. *Spirialis*, sp., and fish eggs were common; and *Themisto bispinosa*, young, the zoeæ of crabs, an dannelids were rare.

May 20, morning (lat. 38° 42′ N., long. 74° 21′ W.); small net, quantity 4 drams. Consisted mostly of *Temora longicaudata*, *Calanus*, sp., *Centropages typicus*, and the zoeæ of crabs. The following were also abundant: Fish eggs, *Sagitta*, *Spirialis*, sp.

May 20, 7.30 p. m. (lat. 38° 50′ N., long. 74° 06′ W.); small net, quantity 6 drams. The bulk consisted mainly of one species of copepod, *Anomalocera Patersonii*, with *Calanus*, sp., and *Centropages typicus*, abundant, and *Candace pectinata*, rare. The following also occurred: Embryo fishes, very abundant; fish eggs, few; decapod larvæ, common; *Themisto bispinosa*, young, few; *Ostracoda*, common; *Sagitta*, few; *Clione limacina*, few; *Spirialis*, sp., abundant; *Pleurobrachia rhododactyla*, abundant. The following insects were taken, from one to three specimens of each: *Geranomyia*, sp., *Eristalis transversus*, *Siphonophora*, sp., *Misumena americana*, *Epeira labyrintha*, young.

May 20, 7.45 p. m. (lat. 38° 50′ N., long. 74° 06′ W.); large net. Contained a few *Sagittas* and a few crustacean larvæ.

May 21, morning (lat. about 38° 56′ N., long. 73° 47′ W.); small net, quantity 1 dram. Consisted almost exclusively of *Anomalocera Patersonii*, which were noticed as the green crustaceans.

May 21, evening (lat. about 39° 26′ N., long. 73° 40′ W.); very small amount, consisting almost entirely of *Anomalocera Patersonii*, as in the previous towing.

May 22, 8 a. m. (lat. about 39° 43′ N., long. about 73° 39′ W.); small net, quantity 1½ drams. *Temora longicaudata*, *Centropages typicus*, *Calanus*, sp., and fish eggs very abundant; larval decapods, *Spirialis*, sp., and *Sagitta*, few; 1 specimen of annelid.

May 22, 8 p. m. (lat. 39° 45′ N., long. 73° 49′ W.); small net, quantity 20 drams. Composed mainly of copepods and larval decapods, the former consisting mostly of *Temora longicaudata*, with *Calanus*, sp., common, and *Candace pectinata* rare; and the latter including representatives of Brachyura, Anomura, and Macrura. Other forms were observed as follows: The young and eggs of several species of fishes;

Themisto bispinosa, moderately abundant; 1 young Cumacean; *Sagitta*, abundant; 3 species of annelids, including *Tomopteris*, few; *Spirialis*, sp., abundant. The following insects were also taken: *Psyllobora 20-maculata*, 1 specimen; *Erioptera* (?), sp., 1 specimen; *Limnophila* (?), sp., 1 specimen; *Anthomyia*, sp., 4 specimens; *Drosophila*, sp., 1 specimen.

May 23, 6 a. m. (lat. 39° 44′ N., long. 73° 46′ W.); small net, quantity 4 drams. Consisted mainly of copepods and larval crustaceans of several kinds. *Temora longicaudata* was the most abundant of the copepods, with *Centropages typicus*, common, and *Candace pectinata*, rare. The following were also represented: Fish eggs, common; *Themisto bispinosa* (?), very young, rare; *Tomopteris*, sp., 1 specimen; *Sagitta*, few; *Clione limacina*, few; *Spirialis*, sp., few.

May 23, 8.20 p. m. (lat. 40° 19′ N., long. 73° 06′ W.); small net, quantity 2 drams. Composed mostly of copepods (*Centropages typicus*, *Calanus*, sp., and *Temora longicaudata*), with an abundance of fish eggs and decayed sea-weed. *Sagitta* was common, and *Themisto bispinosa*, young, and larval crustaceans were rare. One specimen each of the following insects were also observed: *Goniomyia* (?), sp., and *Nemotelus*, sp.

May 26; Fort Pond Bay, Long Island, N. Y.; small net, quantity 1½ drams. Composed mostly of amphipods (*Calliopius læviusculus Bœck*) and copepods, the latter apparently consisting exclusively of *Temora longicaudata*. Fish eggs were abundant, and there were also two specimens of *Pleurobrachia rhododactyla*.

May 30, 9.30 a. m.; Narragansett Bay, R. I. The following species were taken in the dip-net: *Calliopius læviusculus*, 1 specimen; *Idotea irrorata*, 10 specimens; and *Idotea phosphorea*, 1 specimen.

CONTENTS OF THE STOMACHS OF MACKEREL.

May 10 (lat. 38° 07′ N., long. 74° 21′ W.), the stomachs were taken from a number of mackerel, and they or their contents were preserved in four jars of alcohol. The stomachs being preserved, with their contents, in three of the jars, give us the means of measuring their capacity, which averaged 4 drams each, the stomachs being much distended and tightly packed with food. The contents of one stomach consisted almost exclusively of adult *Themisto bispinosa*, which gave to the mass a dark purplish or purplish brown color. *Temora longicaudata* and Nematode parasites were also present in small numbers. In eight of the stomachs the bulk of the contents consisted of copepods, mostly *Temora longicaudata*, with *Pleuromma*, sp., very abundant. *Spirialis*, sp., was abundant, and *Themisto bispinosa*, common, the latter being conspicuous from its darker color and larger size, but forming a comparatively small proportion of the mass. Nematode parasites were also common, and fish eggs rare.

May 13 (lat. 37° 48′ N., long. 74° 13′ W.), a number of mackerel were obtained from the fishing-schooner *Henry Morganthau*, caught with a *purse-seine* in a depth of 37 fathoms. Thirteen stomachs, with their contents, were preserved in alcohol. Twelve of these stomachs were of about the same size, and contained on an average 5½ drams of food; one was considerably larger, and contained 8 drams of food. The species composing the food varied in their relative abundance in the different stomachs, but in all cases the bulk of the contents consisted of copepods, and in some this group of crustaceans formed nearly the entire mass. *Pleuromma*, sp., was apparently the most common of the copepods, with *Calanus*, sp., very abundant; *Candace pectinata* rare to common, and *Centropages typicus* rare. *Themisto bispinosa* was rare to common, and always conspicuous from its color; Macruran larvæ and young Schizopods occurred sparingly; *Sagitta* and *Spirialis*, sp., were abundant. Nematode parasites were common in nearly all the stomachs.

BRYANT WALKER LIBRARY
MUSEUM OF ZOOLOGY
UNIVERSITY OF MICHIGAN

56.—NOTES ON CERTAIN FISHERY INDUSTRIES OF EASTPORT, MAINE, IN 1886.

By R. EDWARD EARLL.

I.—THE WINTER HERRING FISHERY AND THE FROZEN-HERRING TRADE.

The frozen-herring trade of the United States originated with Gloucester fishermen, who brought the first cargoes from Newfoundland in the winter of 1854–'55, and found a ready sale for them at Gloucester and Boston. Others soon engaged in the business, and within a few years quite a number of vessels were employed regularly in bringing frozen fish from Newfoundland to the New England markets.

The hardships encountered in the long and dangerous passage to and from the island during the winter months deterred many who would gladly have engaged in the business from visiting Newfoundland, and these began to look for localities nearer home from which they could purchase their fish. The abundance of herring at Eastport soon attracted the attention of this class, and about 1866 vessels in this trade began to come to this locality, which from its position warranted the using of smaller craft, and from its nearness to the market enabled them to make a much larger number of trips during the season. The greater competition, however, soon advanced the cost of fish so that the profits of the winter's work were usually no greater, if indeed as great, as if the vessels went to Newfoundland. The trade at Eastport has, however, gradually increased, and for the last ten years has had a very decided influence upon the prosperity of the fishermen on either side of the line separating Canada and the United States. The trade has varied considerably from year to year, owing to the mildness or severity of the winter, which has a decided influence upon the industry, a cold winter rendering it prosperous, while frequent thaws often result in serious loss to all concerned, and, owing to the risks incurred, cause buyers to reduce the price of the fish to so low a figure that fishermen are reluctant to catch them. The winter of 1885–'86 was, owing to its fluctuating temperature, a disastrous one, and buyers at Eastport as well as dealers in the larger markets, almost without exception, lost money in the business. Another element which has for the past few years seriously interfered with the demand for frozen herring is the practice adopted by dealers on the Great Lakes and elsewhere of artificially freezing any surplus of lake herring and other species taken in summer, and retaining them until cold weather sets in, when the refrigerators are opened and the fish are placed upon the market. Still another influence which has worked as disastrously as the one already mentioned is the development of large winter fisheries through the ice in the inland lakes of Manitoba, immense quantities of frozen fish being shipped from that region to the western markets, thus overstocking them and reducing the price of fish of all kinds. The winter fishery about Eastport, however, continues to be a very important one, furnishing employment to many men and to a large number of vessels and boats.

A law forbidding the capture of herring on their spawning grounds at the southern head of Grand Manan earlier than October 15 prevents fishing prior to that date, but as soon as the limitations are over a fleet of twenty to twenty-five vessels, mostly from that island and the New Brunswick shore in the vicinity of Eastport, with an equal number from St. John, visit the locality and engage in the fishery, gradually working to the northern end of the island as the season advances and the stormy weather sets in; these being joined by the local fishermen living at the northern end of the island, who set their nets from open boats within a short distance of the shore in the vicinity of their own homes. The principal fishing-grounds at this time however, are between Deer Island and Point Lepreaux, about 30 miles farther east, and in St. Andrew's Bay. The last-named place has less important fisheries than formerly; but the other grounds above mentioned are still the center of the fishery during the winter months. The vessels employed in the capture of the fish are for the most part of an inferior grade and of small size, fully 80 per cent being under 20 tons burden and the largest only 60 tons, while a vessel of over 40 tons is seldom employed. In addition to the vessels, a few of the fishermen living along the shores engage in the fishery from smaller craft and from open boats. The smallest vessels carry only two or three men, while the largest and best equipped may have a crew of ten. These are provided with small net-boats and an average of two nets to the man.

They proceed to the fishing-grounds and anchor in a convenient harbor, using the vessel as a home and workshop and as a storage place for the fish until they can be sold. The season in this locality begins about the 1st of December, and the Grand Manan fleet, which has been employed from the middle of October to November 15, having mended their nets and made preparations, join the fleet in fishing in this vicinity.

The vessels remain at anchor in the harbors, and the boats with the nets aboard are rowed out a few rods from the shore where the nets are sunk from 2 to 10 fathoms below the surface, according to the depth at which the herring are swimming. They are set with, rather than across, the tide, and if the current is strong they are placed singly, but if in comparatively still water two are usually fastened together and set as one. These are placed in the water late in the afternoon, and at the first gray of morning the fishermen start out to haul them. If herring are sufficiently plenty to warrant them in resetting their nets in the same place, they are underrun, the fish being removed and the nets again returned to the water to remain until the next morning, while the fishermen return to the vessel with the catch, or, if the weather will admit, at once spread the fish out upon the shore to be frozen. If, however, the herring are not found sufficiently abundant to satisfy the fishermen, the nets, with the herring still clinging to them, are drawn into the boat, after which they return to the vessel, which gets under way and proceeds to some other locality where it is hoped the fish will prove to be more abundant, the nets being overhauled while on the way and put in readiness for resetting in the afternoon.

The nets used are about 25 to 30 fathoms long, 3 to 4 fathoms deep, and average about 2¼ inches stretch mesh. Nets of good material and properly rigged cost about $20 each. A vessel when properly equipped has two nets to the man, but many of the poorer ones carry an average of only one.

Early in the season, and at other times when the weather is warm, considerable difficulty is experienced in properly freezing the fish, but every opportunity is utilized, and if there is any indication that it will be cold during the night the fish are spread out thin upon the grass or gravel of the shore or upon some convenient wharf. The fishermen visit them frequently at night to stir them, so as to allow those underneath to be exposed and frozen. This is ordinarily done, when they are spread thickly, by kicking or moving them about with the feet, but if the weather is not very cold they are spread so lightly that it is not necessary to stir them.

As the first frozen herring brought to market usually bring a much higher figure than those brought later, an effort is made to utilize the first frosts for this purpose, and usually small lots are obtained by men fishing off the northern end of Grand Manan shortly after the middle of November. During the warmer weather of midwinter the fish are often kept in the hold of the vessel for two or three days until a suitable time for freezing arrives.

The fishermen usually carry their fish to Eastport for a market, but this is not always necessary, as quite a fleet of vessels are employed in moving about among them to purchase any quantity that they may have on hand. Some sell their catch daily, while others freeze their fish and place them in the hold, retaining them for a number of days, so that the catch of a week or more is marketed at the same time.

The fishing continues until early in March, when the buyers are reluctant to purchase any considerable quantity owing to the uncertainty of the weather, which, if it should chance to be warm, might result in the loss of the entire shipment; but as the fish are plenty, the fishermen continue the fishing for from six to eight weeks, selling their catch to be smoked as hard herring or bloaters, or to be salted in barrels. The best fishing occurs during the mildest weather, for at this time the fish play closer inshore, and the nets can be more easily manipulated. During the coldest weather the fish go out into deeper water, and the fishermen are obliged to go farther for them. It is also claimed that strong winds from the north and northwest blows the food of the herring away from the shore, and the herring, which naturally follow it, must therefore be caught at a greater distance. The height of the fishing usually occurs in January, and more fish are perhaps caught during the January thaws than at any other period. The fish are sometimes so abundant that the nets become too heavily weighted with them to stand the strain, and are thus torn to pieces or carried to the bottom, where the fishermen are unable to secure them, and they thus prove a total loss. At such times the fishermen often visit their nets several times during the night to prevent their being overloaded, and enormous catches are frequently made.

Fishermen meeting with exceptional luck have been known to share $50 a day for several consecutive days, but the crew that shares $500 to the man between December 1 and the middle of March is considered to have had excellent success. The average will probably fall below $300, and there are usually some fishermen who do not earn enough to pay for their gear and living expenses while engaged in the fishery.

In addition to the vessels employed in fishing, quite a number of larger vessels from Gloucester and other New England fishing ports are sent to the locality to be loaded with herring, which they carry to market. These remain at Eastport, and the fish brought in by the fishermen and collecting boats are stowed away loose in their holds until they are completely filled, when the hatches are put on and they start for the market.

The desire to get the herring to market as quickly as possible has led to quite a shipping trade by the regular steamers which ply between St. John and Boston. Fish intended to be shipped in this way are packed in barrels, and the steamers frequently carry upwards of a thousand barrels on a single trip. The average charges for transportation by steamer to Boston are from 20 to 30 cents a barrel, and to New York it usually costs about twice that amount; but by sailing vessels the charges average only about 12 cents to Boston and Gloucester, with 3 or 4 cents additional to New York.

During the season of 1885–'86 it is estimated that there were between one hundred and twenty-five and one hundred and fifty vessels engaged in the vicinity of Eastport in the capture of herring to supply the frozen-herring trade. The majority of these were owned by Canadian fishermen at Grand Manan, Deer Island, and the various fishing towns on the Bay of Fundy between the boundary line and St. John. Only thirty or forty vessels belonging to the United States were employed in fishing, though the carrying trade was practically controlled by New England vessels. During this season it is estimated by Mr. R. C. Green, a gentleman thoroughly familiar with the industry, that about 3,500,000 herring were shipped in barrels by steamer, and that between forty-five and fifty cargoes, averaging 300,000 fish each, were sent by vessel. The price paid during the winter varied considerably according to supply and demand. At one time it reached 90 cents per hundred fish, but during seasons of abundance the fishermen found difficulty in disposing of their catch at more than 20 or 25 cents. The average price is estimated at about 40 cents. From this estimate it will be seen that about 18,000,000 herring were shipped during the winter, these netting the fishermen about $72,000. A trifle more than half of the entire catch is sent to Boston, from which point the frozen fish are distributed to the retail trade of the North and West. At least one-half of the remainder go to New York and adjacent cities, where they are purchased by the local dealers and by peddlers. The remaining shipments are divided between Gloucester and Portland, a majority of those sent to Gloucester being purchased by the vessel fishermen of that port to be used as bait in the winter cod, haddock, and halibut fisheries.

With the growth of the industry a disposition has been manifested on the part of the principal dealers of the larger cities to combine to control the trade, and combinations have been frequently formed by which it was hoped to obtain a monopoly of the business. Last year a herring company, in which the leading dealers of New York, Boston, and Gloucester were represented, was formed, and agents appointed to proceed to Eastport to purchase and ship the fish, while others were designated to receive and distribute them on their arrival in market. This company was practically successful in controlling the trade, and fully three-quarters of all the herring were handled by them, though owing to the changeable weather and the abundance of frozen lake herring, white-fish, and other species in the Western markets the business was not a success financially.

As the herring are intended for immediate consumption, our tariff laws admit them free of duty, even though they may be landed in Canadian bottoms. This allows the fish to be brought to Eastport by the Canadian fishermen engaged in catching them, and hence the complications resulting from the termination of the treaty of Washington do not seriously affect this fishery. The determination on the part of the Canadian government to prevent any Americans from fishing within 3 miles of its coast will, however, deter the small vessels from the

United States that have heretofore been employed in catching herring from continuing the business, but as the fleet has been small and the number of American fishermen employed quite limited, the result will not be of serious consequence. American vessels will still retain to a large extent the carrying trade, which is really of greater importance. If, on the other hand, our Government should see fit to impose a duty on the frozen fish caught by Canadians, it would result in great loss to the fishermen of Canada and would prove a hardship which they are not prepared to endure, for the fishermen of this locality are absolutely dependent upon this fishery during the winter months and a very large percentage of their entire income is derived from this source.

II.—THE PICKLED-HERRING TRADE.

The termination of the treaty of Washington and the consequent revival of duties on all kinds of prepared fish has had a very beneficial effect upon the pickled-herring trade of Eastport. As already stated, a large number of men are employed during the winter months in netting herring, which are spread out upon the shore to be frozen, and sold to be shipped in that condition to the principal New England markets; but during prolonged thaws in winter, and after the weather has moderated in spring to such an extent that the fish can not be thoroughly frozen, these continue fishing for herring, and very gladly dispose of their catch to vessels from Eastport that visit the different fishing centers in New Brunswick and purchase the fish fresh to be carried to Eastport, where they are salted and packed in barrels. The Canadian fishermen in this way find a market for their fish at a fair figure, when, if they were obliged to retain and salt them, the United States markets would be practically closed against them, as the duty would be such as to bar them out, for at present prices so small a margin would be left on salt herring and other low-priced fishes, after the duty was deducted, that the fishing would be unremunerative.

The duty, while seriously interfering with the work of the Canadian fishermen, is, on the other hand, very beneficial to the Americans, who buy the fish fresh and bring them to the United States, thus furnishing employment not only for their vessels, but also to American labor in salting and packing them, while the duty, which serves as a barrier to keep out the foreign-packed fish, advances the price to such a figure that those engaged in the business realize a very fair profit from it.

The principal supply of herring for pickling is obtained, as already stated, after the frozen-herring trade has closed in spring, while additional quantities are obtained in the fall from the vessels engaged in netting herring off Grand Manan before the weather has become cold enough to admit of freezing the fish, though a very large percentage of the herring caught at this time are prepared as bloaters.

During the year 1886 between 5,000 and 6,000 barrels of herring were *pickled by* the fishermen and dealers of Eastport and vicinity.

III.—THE PREPARATION OF BLOATER HERRING.

While the smoking of hard herring is very extensive, the bloater-herring business is important. Prior to the termination of the treaty of Washington, Grand Manan, Campobello Island, and other British islands in the vicinity put up considerable quantities of bloaters, which were shipped direct to Boston and New York; but the duty of half a cent per pound or 15 to 18 cents per box is so great, that they can no longer successfully compete with Americans, even though the price of material and labor is considerably cheaper. The principal supply of bloater herring is obtained between the middle of October and the last of November by the fleet of small vessels fishing off Grand Manan. The fish are taken in nets and lightly salted in the vessel's hold until such time as the American vessels that have been sent out to purchase them arrive. They are then transferred to these vessels and carried to Eastport, where they are soaked out, strung, and lightly smoked. They are next packed in boxes of 100 fish each, and shipped to Portland and Boston and other leading cities. Formerly the trade was almost exclusively with Portland, and the fish ultimately found their way to the Canadian markets; but of late increasing proportions are being shipped to the West, and Chicago now receives and distributes a large percentage of the products.

IV.—THE SMOKING OF FINNEN HADDIES.

Eastport was formerly more extensively employed in the preparation of finnen haddies than any other city in the United States except Portland. The trade was at its height between 1875 and 1882, when it gradually began to decline. During the years when the operations were most extensive large quantities of haddies were smoked, nearly all of them going to Portland, from which place they were distributed to the New England retail trade and to Canada; but the development of the sardine interests at Eastport have furnished employment to the American fishermen formerly engaged in catching the haddock, and these have found it desirable to remain on shore. It is also claimed that haddock are less abundant than formerly upon the grounds heretofore visited by the fishermen, who think the fish are now frequenting other localities.

Formerly large quantities were taken in St. Andrew's Bay, but now it is said that scarcely a dozen haddock could be obtained as the result of a day's fishing. The principal fishing-ground of recent years for Eastport fishermen has, however, been in the mouth of the Bay of Fundy to the eastward of Grand Manan, and in the vicinity of the Wolves. Here, too, it is claimed that the haddock have decreased considerably in abundance; but, while this may be true, the fact that those formerly engaged in catching them find employment in the sardine factories and in catching or handling the frozen herring, has probably had a more marked influence upon the haddock fisheries than any decrease in the abundance of fish; for both the sardine and frozen-herring industries have assumed important proportions, and men find remunerative employment in connection with them, thus avoiding the exposures, dangers, and hardships to which they were formerly subjected when fishing for haddock. At present only two firms engage at all in smoking haddock; one of these preparing only sufficient quantities to supply the local trade, while the other smokes small quantities for shipment to Portland. Those best informed estimate that less than 25 tons of haddock were smoked at Eastport during the season of 1885-'86, the few sent out of the city being consigned to Portland dealers.

57.—THE AQUARIUM. A BRIEF EXPOSITION OF ITS PRINCIPLES AND MANAGEMENT.

By WILLIAM P. SEAL.

The history of the discovery and application of the principles of the aquarium is so well known that it is not worth while to repeat it here. Many books have been written upon the subject, all of them in a spirit of glowing enthusiasm, but generally lacking information upon the most essential points, and often grossly misleading as to elementary principles.

A well-managed aquarium requires but little attention, and is a delight to all lovers of nature. It is a living ever-changing picture. On the other hand, under improper conditions an aquarium is a trouble, and is not calculated to give pleasure to the refined and cultivated. Certain conditions are absolutely essential to the successful working of the aquarium. The most important of these is absolute purity in the tank or vessel used, and an abundance of light. When these primary conditions are not obtainable, discouragement and eventual failure are certain. The dealer in aquaria, in his eagerness to make a sale, may advise differently. There is probably no business which has been more abused by false statements and a withholding of the truth, or from ignorance of the subject, and none is more in need of plain truth telling to elevate it to the position it should occupy in affording a means of popular amusement and instruction.

When once properly understood the aquarium, with its varied and interesting forms of life—animal and vegetable—will become as common a feature of household adornment as are birds and flowers.

The newly-awakened general interest in biological research, or, in plainer words, the study of life, has opened up an extended field for the aquarium as the medium for observation of the habits, developments, and metamorphoses of animals and plants inhabiting the water. As an adjunct to the microscope for the amateur or for the specialist, it is an absolute necessity. For the young as a means of encouraging habits of observation and feelings of humanity, as something to give a sense of care and responsibility as well as to interest and take the mind from grosser things, nothing can have a higher value.

THE AQUARIUM TANK.

Aquarium tanks are made wholly of glass, or with a frame-work of some kind of metal, as of iron or brass, and of wood, slate, and marble, or any of these materials in combination with metal.

Glass, slate, and marble being substances devoid of properties having an injurious chemical action in connection with water, or where there is, as in the aquarium, more or less of decomposition of organic matter, need no further mention in this connection.

The iron tank, however, demands especial attention. By reason of the cheapness of the material, by far the greater number of rectangular tanks in use are made of cast-iron. Without entering specifically into the chemical actions involved in the introduction of iron rust (oxide of iron), or of the decomposition of the various varnishes or mineral paints used to prevent oxidation, in connection with decaying organic matter, it need only be stated that they are in the highest degree injurious. Galvanizing is often resorted to to overcome this difficulty, but it is not a satisfactory protection. In the French navy galvanized-iron tanks have been abandoned as receptacles for drinking-water for the reason that poisonous oxides are given off. For the same reason the U. S. Fish Commission has refused to use galvanized tanks on its ships. Undoubtedly the best material for preventing oxidation is a coating of the best grade of Portland cement, which will form, if properly applied, a solid, adhesive, protective surface, perfectly pure and practically indestructible. It is mixed with water and applied like mortar; first, however, scraping from the iron any paint or other substance of smooth and oily nature, to which it will not adhere well. After standing twenty-four hours to set, it should be soaked for two or three days before using, to remove all the lime, the water being changed several times in that interval. At any time that the tank is not in use it should be allowed to stand with water in it, for fear that the cement may crack or become loose from the unequal expansion and contraction of the two substances. Otherwise it is practically indestructible. The cement should not be allowed to touch the glass. It can be bevelled off where it approaches the glass, after it has set, but before it becomes perfectly hard. Portland cement is used exactly as is plaster of Paris, but becomes much harder; in fact, becomes an artificial stone.

THE PRINCIPLES INVOLVED IN THE ESTABLISHMENT OF AN AQUARIUM.

The vessel used is called an aquarium tank. The term aquarium implies such an adjustment of the relations between the animal and vegetable life in the aquarium tank that the one will sustain the other.

It is only when thus arranged that the term aquarium is properly applied.

There is no such thing as an *exact balance*, to be attained and regulated by a nice adjustment and the most scrupulous care, as is intimated in most works on the subject. On the contrary, there must be simply a preponderance of the vegetable or oxygenating element, or, putting it more plainly, the animal life must be limited to what will live comfortably in an aquarium under the conditions in which it is placed, which are so extremely variable that this limit can only be determined by individual observation and experience. All else is mere guesswork.

Oxygen is the element essential to the support of animal life. Carbon is the element essential to the support of vegetable life. Aquatic animals in breathing (*i. e.*, drawing the water through their gills which correspond to our lungs) absorb the free oxygen in the water, and also decompose the atmospheric air held in suspension in the water and absorb or assimilate the oxygen and exhale or throw off carbonic acid gas.

Plants, on the contrary, in growing, *under the action of strong light*, decompose carbonic acid gas—a compound of carbon and oxygen—absorb or assimilate the carbon, and liberate the oxygen. Thus there is a constant interchange of the elements necessary or vital to each. Water is a compound of oxygen and hydrogen, but the water itself is not decomposed, and the oxygen, which is a component part of the water, is not absorbed or diminished, so that in reality the fishes breathe atmospheric air like ourselves and get their supply of oxygen mainly from it.

Now, to show the conditions under which fishes must live in the aquarium, let us use human beings as illustrations. An air-tight apartment containing human beings would be analogous to an aquarium tank filled with water alone, and stocked with fish, except that a small amount of air would be absorbed by the water in the process of evaporation. The conditions are nearly enough alike, however, to illustrate the point. Any school child twelve years of age should be able to point out the fact that as soon as the air in the apartment would be breathed over sufficiently to exhaust the oxygen in it the human beings would suffocate. This is exactly what would take place in the case of the fish. Here, then, comes in the function of the plant life: To renew the oxygen absorbed by and essential to the animal life.

We see, then, that it is absolutely necessary that the aquarium should be placed where it will get strong light. Where this is impossible it is not advisable to attempt to establish an aquarium, as failure would be the inevitable result. The alternative is the fish-tank, without plants and with running water. This advice will apply to those who are attracted by the ornamental beauty of the aquarium without regard to its scientific aspects, and who think that one would be just the thing to fill up some vacant niche or space, which space, however, would be entirely unfitted to the requirements of the aquarium. This would simply lead to waste of money, to vexation and failure, as well as to cruelty to innocent and helpless creatures. It is certainly distressing to any one having the slightest feeling of kindness for dumb animals, and fully understanding the meaning of it, to see a lot of fish gasping for air at the top of an aquarium, absolutely tortured by slow suffocation; for unless relieved, death must result.

STOCKING AND MANAGEMENT OF THE AQUARIUM.

In the internal arrangement of the aquarium we may please our individual fancy. Those, however, who imitate nature most closely, avoiding incongruities—such, for instance, as the use of sea-shells and corals in the fresh-water aquarium—will have aquaria most worthy of admiration. Aside from the unnatural appearance, the use of shells and corals is to be avoided, for the reason that, being soft and easily decomposed forms of carbonate of lime, they introduce injurious chemical action.

There are a great many plants which will thrive in the aquarium. Those most commonly sold for the purpose are Myriophyllum, Ceratophyllum, and a species of Cabomba. They seem to do the best under all circumstances and have from choice the largest sale. There are many others, however, which, although not as large or of as vigorous growth, add very much to the ornamental features of the aquarium. Aquatic plants possess a beauty all their own, and they are the crowning glory of a well-conditioned aquarium, which can be made as beautiful as a wardian case. Those plants which root at all grow readily if fastened in the terra-cotta ornaments sold for that purpose, or if simply planted in the sand and pebbles. Some plants, such as the ceratophyllum and the bladderwort, never root even in nature, but will grow freely either fastened down or floating loose. Care should always be taken not to crush them at the base by binding them too tightly with the strips of soft metal sometimes used to bunch them. The metal can be cut into fine strips, or fine copper wire may be used. If plants which root are crushed, they will rot off before they have time to send out roots and will come to the surface. In this case the fish are generally blamed for pulling them up or eating them off, as they will be seen to eat of the decaying plant as it softens. The arrangement of the plants is of course a matter of individual taste. They may be arranged with mathematical precision, as an orchard would be planted, or mingled with the graceful abandon of nature, as you will.

The use of sand, pebbles, or shingle is also wholly a matter of individual fancy, as it is principally a matter of ornamentation. Sand, or sand and pebbles mixed, forms a compact mass, and as the sediment will collect on the surface of it, it is more easily removed than where pebbles alone are used. The aquarium may be more easily kept clean without any of them and with the plants growing in little pots filled with sand or pebbles. These may be made to look like rock by covering ordinary small earthen pots with Portland cement, or by cementing together pieces of stone.

The stereoptyped question, "How many fish can I keep in my aquarium" is simply offering temptation to the cupidity of the dealers, most of whom will sell you all the fish they can without regard to the consequences to you. In fact, with most of them the governing principle of their business seems to be that the greater the mortality of fish the greater the sale of them. The comparatively few aquaria in use, as well as hosts of abandoned ones, attest the short-sightedness of such a policy.

There can be no rule by which to determine the amount of animal life that can live comfortably in a given quantity of water, it being a question involving the size of the fish, the amount of light (upon which the activity of the plant life depends), and more than all of temperature, which is exceedingly variable. For every 16 degrees of lower temperature water will take up and hold in suspension about double the volume (approximately) of atmospheric air or of oxygen liberated by the plants. Thus it may be inferred that water at 50 degrees will support double the number of fish that could live in the same quantity at 66 degrees. When water is heated on a stove the air will be seen to leave it in bubbles as the temperature rises until all is expelled. After water has been boiled fish can not live in it at all until it is again charged with air by the use of a bellows or pouring it from one vessel into another, thus imitating the revivifying influences of nature in the dashing of the waves or in tumbling it over rocks. Water from which the air has been expelled will again recover its normal proportion of air by absorption alone, but the process will be slower. Good judgment, then, would indicate, in view of the widely-varying conditions to which aquaria are subject, that the path of safety would lie in stocking them to the minimum number of fish only. The question then naturally arises, "How can I know the minimum number?" This is a question which can only be determined by observation, and the only safe plan is to add a few fish at a time. If you should pass the safe limit, there will soon be a lack of air or oxygen in the water, and the fish will keep at the surface, with their mouths out sucking in air, or, in other words, getting their supply of oxygen from the atmosphere itself. When this occurs it will be necessary to diminish the number of fish or to change the water in part at least. The aquarium will be affected unfavorably by a change from colder to warmer weather, as a portion of the air will be expelled. Also by cloudy weather, as the plants lacking the stimulus of strong light will not liberate a sufficient supply of oxygen. If the animal life in the aquarium is limited to what can live in it comfortably under the most unfavorable conditions, it must then be uniformly successful.

Fish should not be introduced into the aquarium until at least a week after the plants are placed therein—except perhaps a comparatively small number to interest the children who are generally extremely impatient to have them—so that the plants may first begin to grow and give off oxygen freely. Others may then be introduced from time to time until the aquarium is fully stocked.

With regard to light it may be said confidently as a result of extensive observation and experiment, that it is almost impossible to get sufficient from a northern exposure, the exception being in bay windows which may catch the morning or afternoon sun for a short time and have a good light generally.

Professor Huxley goes so far as to say that "plants only liberate oxygen under the action of strong sunlight, and in the dark this action is reversed." This would account for the sometimes unaccountable deaths of fish in aquaria, which generally occur at night, when in addition to the lack of light there is less ventilation and greater escape of poisonous gases from gas-pipes and furnaces. These gases are rapidly absorbed by water, and when the conditions are such that there are no counteracting influence their presence must be baleful in the extreme.

In winter the full power of the sunlight may be allowed, but in the summer when the rays have greater heating power some modification is necessary, and the proper mean of sunshine may be found by a little experimentation.

In rooms where there is a high temperature a close-fitting glass cover to the aquarium will be found beneficial. This advice invariably induces the question, "Will not that exclude the air?" The answer is, that in a properly conditioned aquarium the water does not derive any benefit from contact with the more or less impure air of ordinary living rooms at all in proportion to the detrimental influences, but depends wholly upon the plant life for its supply of oxygen. The glass cover prevents the absorption of impurities from the atmosphere and the collection of dust, and by retaining the oxygen which is given off in excess of what the water will hold in suspension there is always a highly oxygenized atmosphere immediately over the water.

Another and very common question is, "How often should I change the water in my aquarium?" A successful aquarium is one which is so stocked and afforded the proper conditions, in accordance with the principles already given, that it will not be necessary to change the water—other than the change effected by supplying the loss from evaporation—except at long intervals, not more than once or twice a year when a general cleansing may be considered desirable.

There are many experienced aquaria fanciers who find no difficulty in keeping (both marine and fresh water) aquaria for many years without change of water. The water should not be changed unless the fish show signs of great distress by keeping their mouths out of the water and sucking in air. This denotes the exhaustion of the air or free oxygen in the water. The water may be re-aerated by the use of a syringe or by dipping it out and pouring it back. The probability is that a small quantity dipped out and replaced with an equal amount of fresh cold water will be all that is necessary. Where the water is completely renewed it should be about the same temperature as the old. Fish are often killed or become diseased by being plunged from water of the temperature of an ordinary living room into water icy cold. Their gills (lungs) become congested, which produces inflammation and ulceration, and they show all the appearance of tuberculous diseases. The smaller the aquarium the more likely it is to be affected by either internal or external influences. The changes of temperature particularly will be more rapid. As before stated, if given proper conditions and not overstocked with animal life, such disturbances very rarely occur and only from accidental causes, such as are always occurring in all the affairs of life.

The ordinary cleansing of the aquarium consists in the cleaning of the glass and the removal of sediment, which latter is easily and efficiently accomplished by the use of a siphon or a pipette, also called lifting tube. This is simply a glass tube drawn in a little at both ends for convenience in using. This is used by holding the forefinger over the opening in the top of the tube and directing the other end over any sediment to be removed. The finger is then removed from the top of the tube when the air escaping the water will rush into the tube, carrying the sediment with it. By again placing the finger over the opening in the top of the tube it can be lifted out with its contents and emptied into some vessel by withdrawing the finger from the opening.

The usual green accumulations on the glass are due to the presence of minute plants known as confervæ. They are generally considered to render the aquarium unsightly. This feeling, however, is not shared by those who are close observers and lovers of nature, for everywhere where even dampness is found this class of plants abound, making hosts of the larger plants and clinging to stones and sticks and even to the earth itself. Viewed under the microscope they are wonderfully beautiful. They are good oxygenators and furnish food for fishes and tadpoles and are really dense forests under the microscope in which myriads of animalculæ harbor and propagate. If so desired, sufficient tadpoles and snails will keep these plants at a minimum, but if the front glass of the aquarium be kept free of them by the use of a small paddle or swab covered with rubber, felt, flannel, muslin, or chamois, they will be found to render it more beautiful by giving it the greenish tinge of nature. An excessive growth of them may also be checked by a modification of the light by the use of screens, for which purpose the use of tissue paper is as good as anything. Some interesting experiments may be made upon the growth of plants by interposing tissue paper of different colors and noting the effect of each after a few days. When the water itself becomes green and opaque from the presence of certain forms of confervæ the best plan is to change the water, although they may be destroyed by diminishing the light sufficiently or by introducing a number of tadpoles.

FEEDING FISH IN AQUARIA.

In feeding the fish care must be taken to introduce no more food than they can eat in a short time, as what is not eaten will soon decompose and make the water cloudy, and generate noxious gases as well. If due care is observed in regard to quantity it does not matter how often fish are fed except that if fed abundantly they will grow rapidly, which is not generally desired. Fish may be fed every day or but two or three times a week with equally good results apparently. They will always find a small amount of food in the aquarium in the vegetation. Where they are not fed sufficiently they are apt to strip the plants of their leaves. In a natural condition fish are feeding continually and grow very rapidly.

The wafer food which is universally sold for gold-fish and other vegtable feeding fishes is a good, nutritious food. Bread, cake, and cracker sour more quickly, and are therefore somewhat objectionable unless carefully used. Most fish, even those supposed to be strict vegetarians, are fond of raw beef. It should be scraped to get the pulp free from muscular fiber, or chopped very fine. Lean beef, unsalted, may be dried quite hard and can then be scraped quite fine. It soon softens in the water, but does not give off the blood as when raw. The fish, however, prefer it raw. Ants' eggs are excellent food. They can be generally bought at bird stores. Oysters and clams, well washed to get rid of the juices and chopped fine, are enjoyed by most fishes. Worms, chopped fine for small fish, are enjoyed most of all. All chance of contaminating the water in feeding the fish may be avoided by having an ordinary confectionery or other jar into which the food may be dropped after placing it in the aquarium. The fish will soon find their way into it. Many of our common brook and pond fishes will eat animal food only, and some of them only living things. Among such are the various sun-fishes, sticklebacks, etc. They are perhaps more lively and interesting in their habits than the more peace-loving vegetarians, the gold-fish and others of the cyprinidæ, but there is more difficulty in finding food for them. A small scoop-net made with cheese cloth and used in almost any quiet water, among the dead leaves, will often yield large numbers of insect larvæ, small crustaceans, which afford them natural and needed food.

DISEASES OF FISH.

Fish are subject to diseases very similar to those of other animals. They are sometimes infested with parasites, some of them microscopic, which will eventually kill them if not removed. The manifestations of disease in a fish are a generally drooping appearance, the fins being closed or depressed, its movements being slow and languid—altogether different from its usually lively and graceful motions. The presence of the microscopic parasites which often infest the gold-fish in aquaria is made known by an inclination in the fish to keep the fins close to the body, at times flapping them rapidly and darting about as if intensely irritated. There will be generally in this case a raw or bloody appearance about the bases of the fins, and at the edges of the scales, and the fins may become closed, the rays being drawn together and terminating in a sharp point. Fish may be freed from these pests by taking them up carefully in a soft net and dipping them in strong salt water for a few seconds once or twice a day, or brushing them with a soft brush or sponge dipped in salt water. Carbolic acid diluted is sometimes used and other remedies are sometimes recommended, but the salt bath is quite as efficacious as any of them, and less dangerous to the fish. Diseased fish may often be cured by putting them in a tub of water with some aquatic plant out in the open air when the weather will permit, or in winter in a light place if with plants, and in semi-darkness if without. Sudden changes of temperature in changing the water are sure to produce inflammation of the gills (lungs) and other diseases apparently analogous to those of mankind produced by similar causes. But little is known of the diseases of fish, and there is plenty of room for experiment in treatment. Very strangely the minute parasites so common to the gold-fish do not appear to infest other kinds. There is a disease quite common among gold-fish and carp, in which there is a quantity of water between the skin and body of the fish, and the scales stand out from the body almost at right angles. They rarely recover and no cure is known. Where fish have proper conditions and are not crowded these diseases are very rare. Fungous growths occur where the scales or mucous covering are scratched or rubbed off. The germs of this class of parasitic plants are generally present in water, and are sure to develop upon any animal, and sometimes vegetable matter which may be present in a state of inflammation or of decomposition. Sometimes the fins of fish will be destroyed by these growths, but will soon grow again when the fungus is removed. The salt-water bath is the simplest and best means of removing or destroying it.

RECAPITULATION.

A brief recapitulation recalls four points demanding especial consideration as absolutely essential to success in the management of the aquarium. They are, first, *absolute purity in the vessel used;* second, *an abundance of light;* third, *to avoid overstocking with fish;* and, fourth, *great care in introducing food into the aquarium.* A careful observance of these principles will lead to success. To ignore them is to invite failure.

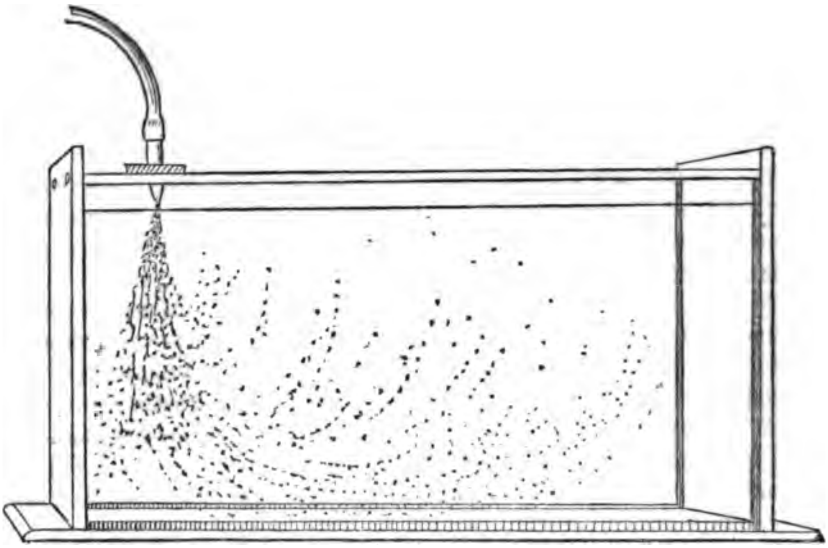
88.—THE KEEPING OF SALMONIDÆ FOR PURPOSES OF EXHIBITION.

By WILLIAM P. SEAL.

Exhibitions of live specimens of the salmonidæ in aquaria, except during the winter months, are so generally attended with great expense, from the supposed necessity for a low temperature and the consequent use of a large amount of ice, as well as the expenditure of much care and labor, that they are considered as not being worth the outlay. Some recent experiments at Central Station, Washington, and in connection with the exhibit of the U. S. Fish Commission at Cincinnati, have demonstrated that all the members of the trout family may be kept much more easily and at a much higher temperature than has been supposed.

It is well known that water takes up and retains in suspension atmospheric air in direct accordance with its temperature. Water is said to be capable of holding in suspension for each 16° of lower temperature about double the volume of air, so that inversely the expulsion of half the volume of air in a given quantity of water would follow a rise of 16° of temperature. This, then, is the cause of the necessity for keeping salmonidæ at a low temperature—as ordinarily kept in limited quantities of water not aerated as in nature by tumbling over rocks and falls and swirling rapidly about, drawing in large amounts of air—the fact that the water does not contain enough air to satisfy their necessities.

The experiments mentioned consist simply in a change in the method of water supply, by which, with the use of a small amount of water, a large proportion of air is introduced well dispersed in very minute bubbles, in which shape it is rapidly absorbed by the water. The method consists in the use of very fine nozzles of from one-sixteenth to one-eighth inch orifice. The point of the nozzle is fixed close over the surface of the water either straight or obliquely. The stream of water impinging on the surface of the body of water in the tank, with force, carries in with it a large amount of air, which is very minutely divided and dispersed, thus keeping the water well charged with air. This of course requires force, which is always available where there are systems of water-works. Elsewhere it would be necessary to have an elevated tank and some means of pumping water thereto to get the necessary pressure. An elevation of 20 feet will give sufficient pressure to force a one-sixteenth-inch stream of water to the bottom of a body of water 3 feet deep. A number of such streams might be found necessary, varying with the size of the tank, the number or kind of fish, etc. In an ordinary-sized aquarium tank, say 18 by 18 by 48 inches, or 24 by 24 by 48 inches, one, or at most two, streams would probably be found sufficient. The large amount of air thus constantly forced into the water gives the fish the needed supply of oxygen at a comparatively high temperature, which is apparently more enjoyable to them than a lower one, as they are undoubtedly more active and playful. By this means trout may be kept at a temperature of 70° without noticeable discomfort to them, although, perhaps, 60° to 68° is a safer and surer limit, in view of possible accidents. The accompanying figure will illustrate the method in question.



The great efficiency of this method of water supply over any other has been fully demonstated in the keeping of marine fishes at the marine station of the Commission at Wood's Holl, Mass. Many marine species require even more oxygen than the salmonidæ, and thus the system has received substantial tests, and can be confidently recommended not only on account of the introduction of a large amount of air and a saving of ice and labor, but on the score of economy of water also, which is very often a matter of considerable importance. When the temperature rises above 70° it can be cooled by introducing the necessary amount of ice directly or by passing the water through a coil of pipe surrounded by ice. The retardation of the stream of water by the use of the very small nozzles gives it ample time to cool, and it can be brought down to a very low temperature. As ordinarily used the pipe coil has been a failure, because the water passed through it too rapidly to be cooled. At the Cincinnati Exhibition the water in an aquarium tank 18 by 18 by 48 inches was kept at a temperature of 48° by passing it through 70 feet of one-fourth-inch lead pipe coiled in an ice-chest 18 inches square, and from that through about 30 feet of rubber tubing wrapped with newspapers, passing into the tank in a one-sixteenth-inch stream.

In changing trout from iced water to aquaria operated in this way it would be necessary—at all events safer—to bring the temperature up gradually.

At the Cincinnati Exhibition the temperature was raised from 59° to 70°, a change of 11° in the course of five or six hours, without any noticeable effect, on a lot of brook, Loch Leven, and brown trout.

59.—AN INQUIRY AS TO THE PROPER METHODS FOR THE CARE OF LIVING THINGS HELD FOR POPULAR AMUSEMENT AND INSTRUCTION OR FOR PURPOSES OF BIOLOGICAL RESEARCH.

By WILLIAM P. SEAL.

The object of this paper is simply to provoke inquiry as to the proper methods of confinement and treatment of living things—aquatic or terrestrial—whether held simply for popular amusement or for the higher purpose of biological research.

The subject of biological research is one of rapidly-growing importance. Aside from the demands of specialists for facilities for pursuing their investigations, the value of such work in the interest of general education is meeting with wide-spread public recognition, and it is now only a question of time when extensive aquaria and vivaria will become important and necessary adjuncts to the biological laboratory.

In the more practical domain of fish-culture there is a great and as yet untouched field and vast possibilities in the introduction and acclimation of foreign fishes and in experiment leading to the possible transfer of valuable salt-water species to fresh water by gradual change of density, as well as the opportunity for the study of their complete life histories.

Candor compels the acknowledgment that a retrospective review of the scientific results attained through the media of zoological gardens and large aquaria generally, since their first establishment, would show nothing commensurate with the immense outlay involved, and it is a question in the minds of many persons of experience in such matters whether better results are possible. The writer has arrived at the conclusion that nothing better can be expected under existing methods.

As before suggested, the object of this paper is simply to provoke discussion, leading, if possible, to the establishment of other and better methods. The observations of the writer upon animals held in confinement have led him to the conclusion that for purposes of biological research—involving the normal discharge of the natural functions—psychological influences must be taken into consideration as well as those of a purely physical nature, the one having a direct bearing on the other. In other words, animals must be provided with homes adapted to their varied requirements, instead of being held in what can only be termed *prison-pens*.

In a previous paper* the writer gave suggestions regarding the establishment of homes for aquatic and amphibious animals, but more especially adapted to those of smaller size. Those suggestions were made on the test of actual experiment. The question arises whether the same methods on a scale of magnitude adapted to the largest animals would not produce equally satisfactory results. Undoubtedly by far the greater cost of maintenance of large aquaria and zoological collections is due to excessive mortality. The laws which apply to the herding or imprisonment of men apply with greater force to the lower animals, which are less amenable to artificial conditions. Fishes confined in small bodies of water are infested with parasites, which do not trouble them in ponds and streams where they have mud, sand, masses of plants and rocks, by means of which they can rid themselves of such pests. Fishes and reptiles, and I doubt not other animals as well, are also undoubtedly subject to diseases analogous to scurvy and others of that nature produced in man by close confinement and consequent impurity of surroundings.

There is another aspect of the case, that of the effects of imprisonment upon the mind. Most persons are familiar with the fact from personal observation that it is almost impossible to confine many of our adult wild birds in cages; as they will refuse to eat and will speedily die of starvation, or will beat themselves to death on the wires of their cages. Those who have had exeperience in the care of fishes will have noticed the same results in the cases of many kinds of them. It is impossible for an observing person at all experienced in the care of animals of whatever nature not to concede to them the emotions pleasurable or unpleasurable common to mankind regarding surroundings.

Nothing can be more depressing to the lover of nature than the forlorn and dejected appearance of the birds and beasts of fiercer nature as they appear in the limited areas and unnatural surroundings allotted to them in zoological gardens.

Prof. H. C. Chapman states as a result of his examinations of carnivorous animals which have died in captivity, that most of them die of heart disease.

From this benevolent view alone, therefore, this question is one well worthy of consideration. Surely, if the dumb brutes contribute to our pleasure or benefit, we may well afford to consider the possibility of making them measurably contented and happy.

With this idea in view I offer the following suggestion for the consideration of those interested in the establishment of large aquaria, hoping for further development through interchange of ideas.

The plan or principle herein suggested might be termed not inaptly Pond-Aquaria, it being essentially a combination of the pond and the aquarium; the aquaria being constructed on the margin of the pond or reservoir used, as shown in the accompanying illustration, Plate I; the idea being to have a water-pen or pond-garden (A) extending back from each aquarium front, and to be surrounded by a wire or other fence or partition (B) of sufficiently small mesh to prevent the escape of the occupants, but large enough to allow the smaller fry, which would furnish them with food, to pass through freely. (C) represents the glass fronts. (D) the upper or perforated aquarium bottom, which allows the escape to a lower funnel-shaped bottom (E) of all sedimentary deposits. (F) represents rocky eminences containing pockets, in which could be planted aquatic vegetation at depths adapted to their needs. The whole creating a close approximation of natural conditions. An arrangement of wire gates would keep fishes in close confinement for short periods for observation, or would keep some, while others were allowed to roam at will in their domain.

---

* **The Aqua-Vivarium as an Aid to Biological Research. Report U. S. Fish Commission, 1883.**

Plate II represents a cross-section of the same, showing building over the aquaria, and greenhouse roof to pond-gardens.

The advantages of some such plan will, I think, be apparent to all who have experience on the subject at least. It is simply imitating nature more closely and getting rid of artificialities.

The conditions would afford natural vegetation, sunlight, mud, sand, and rocks, with abundance of room in which to move about freely and seek for natural food.

By such a plan also the necessity for circulatory apparatus is dispensed with, the circulation caused by the movements of the fishes, changes of temperature and evaporation, together with the aeration or oxygenation effected by the plant life being ample as in the pond.

It might be argued that, with so large a space, fishes would keep hidden from view. The experience of the writer has been that when the fear of danger is removed and animals become confident of an ability to escape at will when threatened by danger they lose their timidity and become both bold and curious, and are more easily and satisfactorily viewed than when under the influence of fear in close confinement. The deer, the most timid of animals, when confident of safety, becomes perfectly content, and without desire to escape except to seek its kind for company.

The experience of the writer in the care of fishes and reptiles and other animals as well, is to the same effect.

60.—THE BEAM-TRAWL FISHERY OF GREAT BRITAIN, WITH NOTES ON BEAM-TRAWLING IN OTHER EUROPEAN COUNTRIES, ETC.

By J. W. COLLINS.

ANALYSIS.

Page.
A. Introductory note 290

I.—THE BEAM-TRAWL FISHERY OF GREAT BRITAIN.

B. History and present importance 291
C. Fishing grounds 296
D. The fishermen 300
E. Vessels 305
F. Fishing apparatus 310
  1. The beam-trawl 310
    (a) The beam 311
    (b) The trawl heads 312
    (c) The trawl net 316
    (d) The trawl warp and bridles 321
    (e) Dimensions and method of construction 321
  2. Apparatus for operating the trawls 324
    (a) Capstan 325
    (b) Dandy winch or wink 326
    (c) The forward winch 327
    (d) The "dummy" or towing bollard 327
    (e) Trawl-warp rollers 327
    (f) Dandy-bridle chock 328
    (g) Fish tackle 329
  3. Apparatus for packing fish, etc 329
    (a) Fish boxes 329
    (b) Ice mill 330
    (c) Boats 331
    (d) Doddle net 331
G. Methods of fishing 332
  1. General description of the use of the beam-trawl 332
  2. Shooting a trawl from the port side 333
  3. Shooting a trawl from the starboard side 337
  4. To change the tack with the trawl out 338
    (a) To wear the trawl around 338
    (b) To stay the trawl around 339
    (c) To drop a vessel around with her trawl out 339
    (d) To catch a vessel around with a weather tide 340
  5. To prevent a vessel from catching around 340
  6. The working of a trawl 340
  7. Heaving up the trawl 342
  8. Single boating and fleeting 348
  9. Care of fish, "boarding" fish, etc 354
H. Marketing the catch; fish carriage, etc 359
  1. Landing the fish at Billingsgate 359
  2. Selling fish by auction 360
  3. Fish sale at Brixham 362
  4. Shields as a fish market 363
  5. Fish carriage 365

Page.
I. Method of dividing the profits 367
J. Effect of beam-trawling on the abundance of fish 369
K. A cruise on a British North Sea trawler 373

II.—NOTES ON THE BEAM-TRAWL FISHERY OF CONTINENTAL EUROPE.

A. France 388
  1. Fishing grounds 388
  2. Vessels 389
  3. Apparatus 389
  4. Methods of fishing 390
B. Belgium 390
  1. Fishing grounds 390
  2. Vessels 390
  3. Apparatus 391
  4. Methods of fishing 393
C. Holland 393
  1. Fishing grounds 393
  2. Vessels 393
  3. Apparatus 395
  4. Methods of fishing 397
D. Germany 398
  1. Fishing grounds 398
  2. Vessels 398
  3. Apparatus 399
  4. Methods of fishing 399
E. Spain 399
  1. The "bou net" or parella 399

III.—ATTEMPTS TO USE THE BEAM-TRAWL IN THE FISHERIES OF THE UNITED STATES.

IV.—POSSIBILITIES OF SUCCESSFULLY USING THE BEAM-TRAWL IN THE SEA FISHERIES OF THE UNITED STATES.

A. INTRODUCTORY NOTE.

This report has been prepared for the purpose of placing before those directly interested in the fisheries of the United States such information as seems necessary to convey a moderately comprehensive idea of the British beam-trawl fishery. The history, development, and importance of this special branch of the fisheries in European waters have been dwelt upon at some length. Attention has been called to the possible influence of the beam trawl on the abundance of fish, and the question of the introduction of this form of apparatus into the fisheries of the United States has been discussed.

But in view of the possible employment of the beam-trawl for the capture of fish in American waters, special attention has been given to the various details of its construction. It has also been deemed desirable, for the same reason, to describe at length the various forms of apparatus which are used in conjunction with the trawl, as well as the methods of fishing, the system of marketing the catch, and other matters relating to the prosecution of the work in Europe, since a knowledge of these details will be required by American fishermen should they ever undertake to prosecute the beam-trawl fishery.

Less has been said concerning those subjects which seem to suggest little that may be of practical value, and for this reason much has been omitted which might perhaps appropriately be included in a report of this kind. For instance, the notes on the trawl fisheries of France, Belgium, Holland, Germany, and Spain might have been expanded to a greater extent, but it is believed that these contain all the data which may be of any importance to fishing communities in the United States.

It is proper that acknowledgments should be made to the following gentlemen, who have lent their aid in various ways, but more particularly in furnishing such information as is required for a work of this character. Foremost among those who have assisted by their kindly efforts are Mr. Harrison Mudd and Mr. O. T. Olsen, of Grimsby, Mr. Edward Jex, of London, and Mr. T. F. Robertson Carr, of North Shields, while others have furnished much interesting and valuable data concerning the British beam-trawl fishery.

Mons. A. Duchochois, of Boulogne, has supplied data relative to the French beam-trawl fishery. Mons. Jules Le Lorrain, of Belgium, has furnished many important facts concerning the fisheries prosecuted from that country. I am also indebted to Mr. A. E. Maas, of Scheveningen, for information relative to the Dutch trawl fishery.

The material upon which this report is based was chiefly gathered at Grimsby and Hull, and during a trip to the North Sea in 1880; also from a study of apparatus and methods at the International Fisheries Exposition at London in 1883. So far as I am informed, however, there has been little if any change since the last-mentioned date, beyond perhaps the introduction of additional steam-vessels in the beam-trawl fishery from the continental ports.

I.—*THE BEAM-TRAWL FISHERY OF GREAT BRITAIN.*

B. HISTORY AND PRESENT IMPORTANCE.

Nothing definite can now be learned as to where or when the method of fishing with a beam-trawl in Great Britain originated. Undoubtedly trawl-nets of some kind have been in use for many centuries off the English coast, but there remain no records which would suggest that they were supplied with a beam to distend their mouths, and as the most primitive and oldest forms of trawl-nets now in use are unprovided with beams, it is probable that those first employed in England were of this type.

The earliest notice which we can find of the trawl fishery in England is contained in the following petition, which was presented to Parliament in 1376–'77:[1]

---

[1] It will be noticed that there is nothing in this petition which indicates the use of a beam as a part of the apparatus; therefore one is left in doubt as to whether a beam-trawl or some other form is meant.

(Pet. 51, Edw. III, A. D. 1376–'77.—Petition No. 50.) "That whereas in several places within your said realm, in creeks and havens of the sea, where was accustomed before these times to be a good and plenteous fishery to the great profit of the realm, which is in part destroyed and rendered valueless for a long time to come, by some fishermen who have for times during seven years past by a subtlety contrived a new instrument, which is amongst themselves called a 'wondy choun,' made after the fashion of a 'dag' for oysters, which is usually long, to which instrument is attached a net (*ree*) of so small a mesh, no manner of fish, however small, entering within it can pass out, and is compelled to remain therein and be taken. And besides this, the hard and long iron of the said 'wondy choun,' that it destroys the spawn and brood of the fish beneath the said water, and also destroys the spat of oysters, muscles, and other fish by which large fish are accustomed to live and be supported. By means of which instruments called 'wondy chouns' in many places aforesaid, the fishermen aforesaid take so great abundance of small fish aforesaid, that they know not what to do with them, to the great damage of the commons of the kingdom, and the destruction of the fisheries in like places. For which they pray remity.

"*Responsio.*—Let commission be made by qualified persons, to inquire and certify on the truth of this allegation, and thereon let right be done in the court of chancery."

The fishing towns of Brixham and Barking, in their local traditions, both lay claim to the distinction of having been the first to introduce and establish the method of fishing with beam-trawls, but, as these claims are based solely on tradition, it still remains a mooted question as to which is the most entitled to the honor. One writer has attempted to prove the probability of this method of fishing having been introduced by the Dutch on the occasion of the landing, at Brixham, of the Prince of Orange in 1688.

He says, however, that "for the next hundred years there was no craft employed at Brixham at fishing, but open boats and half-deck yawls, the latter being the latest improvement. We have [he continues] heard our grandsires relate how they used to put the whole apparatus, or gear, as it is now called, on their back and carry it on board of the boat. * * * Shortly after this time the fishermen began to enlarge their crafts, to cover in the deck, fore and aft, and rig them as cutters—namely, boom, gaff, and bowsprit, and with topmast having a long pole on which was set a royal with the sheets leading down on deck, the same as the Dutch Scheviling bombs of the present day, and most probably the rig was taken from them."[1]

The trawl-net, in various forms, has unquestionably been used in the continental fisheries of Europe for many years, but the application of the beam is apparently of more recent date.

---

[1] The Fisherman's Magazine, March, 1881.

The following remarks by Holdsworth on the origin of the trawl-net, though they do not throw any additional light on the matter, show, nevertheless, how difficult it is to find anything concerning the early history of this apparatus which may be considered reliable:

"The origin of the trawl-net appears to be unknown, but an eminently primitive method of working it is still in use on the Atlantic and Mediterranean coasts of Spain. * * * Its chief feature is that in order to keep the mouth of the net open so as to work efficiently, two vessels are employed. They are termed 'Parejas,' signifying pairs or couples, and they sail together at a certain distance apart, towing the net between them. An improvement on this plan, although very far from being satisfactory, is the hammer or pole-trawl, still used on some parts of the south and southwest coasts of Ireland. Only one vessel is required to work it, and the mouth of the net is extended by ropes leading from wings of netting on both sides of it to poles projecting one on each side of the vessel. It is but a clumsy contrivance, and only suited to smooth and shallow water. * * * The otter-trawl is the same kind of net as the one just noticed, but otter-boards are fastened to the ends of the wings, and by their peculiar and kite-like action cause the extension of the mouth of the net without any necessity for poles. The otter-trawl is much used on board yachts, but does not meet with much favor from professional fishermen. Their preference is given entirely to the beam-trawl, which has been in use for many years, and, notwithstanding some disadvantages, has on the whole proved to be a productive and useful implement of fishing. There is nothing to show when the addition of the beam was first made to the trawl, nor is it certainly known whence the idea originated. There is some reason to think, however, that to Brixham is due the credit of having first adopted it in this country for deep-sea fishing, and possibly of having introduced it, although we believe Barking also puts in a claim to it. The commencement of the system probably dates from some period in the last century. Old fishermen at Brixham remember their grandfathers being trawlers; but the number of vessels and their size were then small compared with those of the present day, and we can obtain no further information on the subject than that beam-trawling had been carried on for a long time, or, as was said by one old fisherman, whose chronological ideas were perhaps not very clear, 'may be from the time of Moses'—a possibility not quite consistent with the general idea at Brixham that beam-trawling originated in that long-famous fishing port."[1]

Although we may be left in doubt as to the time and place that witnessed the introduction of the method of beam-trawling in Great Britain, it is, nevertheless, a well-established fact that this fishery did not attain very important proportions until within the present century. Of late years, however, more especially since 1850, it has developed with remarkable rapidity, until now it is considered one of the most important fisheries of the British Isles, while in England it takes precedence of all others.

---

[1] *Deep-sea Fishing and Fishing Boats*, by Edmund W. H. Holdsworth, London, 1874, pp. 52, 53.

"The most important method of fishing," writes Holdsworth, "by which a regular supply of the best and most varied kinds of sea fish is obtained for the market is that commonly known as 'trawling'—a name evidently derived from trailing or dragging; the trawl being a bag-net which is towed, trailed, or trawled along the bottom; and it is so constructed as to capture those fish especially which naturally keep upon or near the ground."

The most noted ports in England from which trawling is prosecuted are on the east coast and most of them north of the Thames. They are, in the order of their importance as trawling stations, Yarmouth, Grimsby, Hull, Lowestoft, London, and Scarborough; while Brixham, Ramsgate, Plymouth, and Dover, in the south of England, are noted for their trawling fleets. Carnarvon and Tenby, in Wales, have small fleets of trawlers.

Aberdeen, Granton, and Leith, in Scotland, have each a number of trawling steamers,[1] though Mr. T. F. Robertson Carr, writing from Edinburgh under date of August 25, 1883, says:

"The General Steam Fishing Company, limited, is the only beam-trawling company of any importance in Scotland, and their headquarters are at Granton in the Firth of Forth, close to Leith."

When Holdsworth wrote in 1874, there was "no beam-trawling station of any importance on the coast of Scotland." The statement is made in the First Annual Report of the Fishery Board for Scotland, 1882, that—

"Beam-trawling has been carried on for several years in the Moray Firth by sailing smacks and boats, principally belonging to Lossiemouth; and it has also been prosecuted for a considerable period by sailing smacks and boats in the Firth of Clyde. Beam-trawling by steamers, which has been more recently adopted, has greatly increased within the last two or three years."

According to the Scotsman of December 8, 1883:

"At the present moment the fleet of screw trawlers belonging to Granton numbers fifteen, and the capital thus employed in the industry here alone may be roughly estimated at between £40,000 and £50,000."

Dublin, Galway, Waterford, and Dingle are the principal stations in Ireland from which large vessels are employed in trawling.

Besides all the fleets of large sailing smacks and steamers which engage in this industry, more or less trawling is carried on near the shore on various parts of the coast of the British Isles, by small boats, but until recently the Scotch have employed this method comparatively little, and even now other means of catching fish are generally preferred by the boat fishermen of that country.

---

[1] Mr. David Allen, senior member of the building firm of D. Allen & Co., of Granton, states that, in 1883, Aberdeen had five screw boats and five paddle steam trawlers; Granton had a fleet of nine screw steamers, while a dozen side-wheelers sailed from Leith. David Walker, trawl owner and skipper, of Johnshaven, before the Royal Commission appointed to inquire as to trawling operations on the east coast of Scotland, 1883, says: "There are now seven sailing trawlers and one steam trawler belonging to Johnshaven, working generally from Red Head down to Bervie. *Formerly they went to* Aberdeen Bay."

The remarkable development of the beam-trawl fishery of the east coast of England during the past forty years, the consequent increase in the trawling fleets, and the growth and prosperity of the principal fishing ports are, perhaps, without a parallel in the history of the British fisheries.

Take Grimsby, for example, which, about 1858, according to Mr. Harrison Mudd, a prominent citizen of that port, had a population of, approximately, from 10,000 to 13,000, and had just begun its career as a fishing town by sending out a few beam-trawlers; now it has increased to upwards of 30,000 inhabitants, and from its docks sail a fleet of nearly 800 fishing vessels, more than half of which are beam-trawlers. Mr. Edward Jex and other gentlemen say that they can recollect when Hull and Lowestoft (some thirty-five or forty years ago) did not have more than 25 or 30 sail of trawlers to each port. In 1881 Hull had a fleet of 737 and Lowestoft 467 vessels of all classes, the majority of which were trawlers.

"The rapid development of late years," writes Mr. Ansell, "may be traced to the introduction of ice and the spread of our railway system, by which the catcher has been enabled to get the fruits of his toil distributed to the many thousands dwelling in the inland towns—those who seldom or never saw or tasted salt-water fish."[1]

It may also be added that the introduction of the method of icing fish has given the trawlers an opportunity, which they have not been slow to improve, to visit distant and untried grounds where fish could be taken in much greater abundance than nearer home.

According to Mr. Ansell the advance of the trawling trade was so rapid on the east coast that Hull, which, in 1845, had only 21 vessels, aggregating 570 tons, and valued at £6,425, had, in 1882-'83, increased its fleet to 417 smacks, besides 9 steam carriers and 6 ice ships, with a tonnage of 29,233 tons, and a valuation of £555,000.

Still more remarkable has been the growth of the beam-trawl fishery from Grimsby. It was first introduced, according to Holdsworth, in 1858, at which time 5 smacks went there from Hull. The rapid strides which this fishery has made at that port may be judged from the fact that the amount of fish landed there had increased from 4,344 tons in 1858 to over 73,000 tons in 1881, while we are credibly informed that about 100,000 tons were landed in 1882-'83. Though all of these fish were not caught in beam-trawls a large percentage were so taken, and it is perhaps not too much to assume that the increase in the fisheries at Grimsby is due more to the advance made in beam-trawling than to anything else. Besides the fish landed at Grimsby, large quantities caught by trawlers hailing from that port go by water in steam carriers to London.

---

[1] Papers of the conferences held in connection with the Great International Fisheries Exhibition (London, 1883), On Trawling, by Alfred W. Ansell.

As to the present status and importance of the British beam-trawl fishery, Mr. Ansell makes the following interesting statements:

"The number of British deep-sea trawlers may be taken at 3,000 (not including steam cutters), Yarmouth leading with 700, Hull and Grimsby next, making together about half the number, the rest being scattered around our coasts. Such smacks as sail from Yarmouth, Hull, and Grimsby I class as the deep-sea trawler. Taking the average catch of each of these at 100 tons, brings the total weight to 300,000 tons, irrespective of the inshore trawlers' catches (as in the case of Hull and Grimsby, and also Messrs. Hewitt's), and others *less* of coarse and *more* prime, we may take an estimate at £10 to £12 per ton as the price it fetches; this will give us a total money value of fish caught by the deep-sea trawler of £3,000,000 at £10, or £3,600,000 at £12."

The Duke of Edinburgh, in a paper read at the conferences at the London International Fisheries Exhibition, entitled "Sea Fisheries and Fishing Populations," makes a more moderate and probably a more accurate estimate. He places the total production by this method in the British Isles at 215,157 tons, worth £2,581,000, equal to about $12,905,000.

"If," continues Ansell, "we take capital employed in producing this at a total of £15,000,000 invested in floating and shore property, it is not overestimating it. We have ice-ships, ice-houses, steam-carriers, curing-houses, storing-houses, and many other things too numerous to mention. The number of hands to man these vessels, at five or six hands per ship (though some carry more), makes from 15,000 to 18,000; the latter is more like the number. If to this we add 2,000 who are out of berth by changing ships, we have then 20,000 hardy and experienced hands employed in deep-sea trawling, and who have no *other calling or occupation.* Some of these have families, and calculating two only in each ship to be married, with each a wife and four children, we have 30,000 more who are *altogether dependent on the trawl for support.* But as the trade can not be carried on without assistance of shore labor, it gives employment to more than as many more, such as packers, curers, laborers, watchmen, coopers, net-makers, riggers, etc., and a vast number of other trades too numerous to mention."

C. FISHING GROUNDS.

The North Sea or German Ocean, from the Straits of Dover to Kinnaird's Head, on the Scottish coast, and the Skager Rack, on the continental side, is the most favorable field for the prosecution of the beam-trawl fishery. Within the area mentioned the water is generally shallow, varying from 5 to a little upwards of 50 fathoms, and may be considered one vast fishing bank, though there are various areas of greater or less extent in this part of the North Sea that are specially noted trawling grounds, and to which specific names have been given.

A bottom of mud or sand, in a moderate depth of water, is the most favorable ground for the use of a beam trawl, providing, of course, fish can be taken thereon; but it often happens that fish are much more abundant on rocky grounds, known by the name of "roughs" among the North Sea fishermen. Therefore, though there is always a great risk of losing the trawl when working on rough bottom, the hope of obtaining a large catch is often sufficient inducement for the fishermen to make the venture.

The most noted of the North Sea fishing grounds is the Dogger Bank (divided into several sections, which are distinguished by local names): the Off Ground, the Great Silver Pits, Botney Ground, Brown Bank, the Coast, Leman Ground, and the Great Fisher Bank. Besides these, mention may be made of the Horn Reef, Jutland Reef, Flamborough Head Ground, Scarborough Ground, Hartlepool Ground, Sunderland Ground, Fladen Ground, the Cemetery, Flat or Well Bank, Sole Pit or Northeast Hole, Smith's Knowl, Cromer Knowl or Dowsing Ground, the South Ground, North Foreland Ground, Kentish Knock Ground, Margate Ground, the New Bank or Sandiethe, the Falls Ground, Ridge and Varn Banks, and Rye Bay.

"The fishing grounds most frequented by vessels from the Humber [Hull and Grimsby]" writes Mr. Ansell, "are the shoal of the Dogger, the southwest and northwest spit of the Dogger, Clay Deeps, the northeast part of the Dogger (called the 'Cemetery,' from the rough, stony nature of the bottom compared to grave-stones), the Fisher Bank and beyond the Fisher Bank, Jutland Reefs, the Long Forties, the Horn Reefs, the Sylt, the Amram Bank, Heligoland, off the entrance of the Weser and Elbe, Nordeney, Borkum, Terchelling, Texel, etc., besides other grounds south of the Humber, such as the Wells Bank, etc. * * *

"Plaice are to be found only in the spring and fall on the shoal of the Dogger, and in summer on the Horn Reef and Borkum. In winter, below the Dogger and off the Flamborough Head.

"Haddocks are found in abundance on the southwest spit of the Dogger about October; in September and October they work along the pit edge of the Dogger, and when taken they are found to have plenty of herring and spawn in them.

"Soles are caught on hard, sandy ground in warm weather, taking to deep water, such as the pits, where the bottom is muddy and soft, in winter, for warmth."

The Dogger Bank, which is a very extensive ground, is situated nearly in the middle of the North Sea; its southwest proug is about 70 miles in an east-northeast direction from Spurn Point, at the mouth of the Humber. From there it extends northeastwardly a distance of 150 miles, ending in a point. It is somewhat irregular in form, being about 60 miles wide in the broadest place. Different parts of the Dogger are known by specific names among the fishermen. The "West Shoal," which is a shallow ground on the southwest part of the bank, is about 20 miles long ESE and WNW., with a depth of from 7 to 10 fathoms, and a fine sandy bottom. Then there is the "Outer Well Bank," or the "Southwest Spit," with from 15 to 18 fathoms, with a bottom of fine sand and occasional spots of coarse sand and small rocks. In this locality haddock and plaice are frequently found in abundance during the fall. Between the Southwest spit and the West Shoal the shallow part of the bank curves inwardly like a cove, with irregular soundings, varying from 20 to 40 fathoms. On what is known as the south part of the bank, east of the West Shoal, the bottom is chiefly fine sand, with a depth of from 14 to 20 fathoms. This is a good fishing ground, and is much visited. The "East End," in latitude 55° 25′ north, longitude 4° 30′ east, is noted for a fine brown sandy bottom, free from what the fishermen call "scruff" or "rubbish," the depth varying from 22 to 24 fathoms. This is now considered one of the best fishing grounds on the Dogger. To the southwest, in latitude 54° 50′ north, longitude 3° 20′ east, is the "Clay Deep," or "Southeast Swash of Dogger Bank," of soft ooze, 25 miles long, southwest and northeast, with rough ground on either side. The "North Shoal" and "Northwest Spit" are tracks of more or less rough bottom.

The Great Silver Pits, the west end of which lies due east of Spurn Point some 60 miles distant, is a gully or depression of the sea bottom between the Dogger Bank on the NNE. and Wells Bank on the opposite side. Its length east and west is about 60 miles, and its width varies from 10 to 14 miles. The depth ranges from 25 to about 50 fathoms, with patches of bottom of different kinds, such as black mud, fine sand, white mud, blue clay, stones, and gravel.

This celebrated fishing ground was discovered about 1843, and on it soles were found in extraordinary abundance.[1] It still is a favorite resort in winter for such of the trawlers as fish more particularly for soles.

The Great Fisher Bank is thus described by Olsen:

"This large space of ground, known by the name of the Great Fisher Bank, is situated in the northeast part of the German Ocean; it is of vast extent, and has recently been discovered as a trawling ground. The ground chiefly consists of sandy soundings of mud and ooze, with depths of water varying from 40 to 45 fathoms.

---

[1] Dr. Francis Day, in "Notes on Trawling," published in "Ashore or Afloat," London, 1883, states that: "When the Silver Pits were first discovered it was not an uncommon thing for a trawler to get a ton and a half of soles a night, of from £12 to £24 value."

Olsen says: "Large quantities of soles were caught for the first three years."

"When the Silver Pits were first discovered," writes Ansell, "and became frequented as a fishing ground, the sole was found in the winter months in such enormous *quantities, that the name 'Silver Pits' was to the fishermen no unmeaning one, so prosperous were those who resorted thither.*"

"The best track hitherto used (1877) is in latitude 57° 20′ north, and longitude 1° 40′ east. * * * As the bank is of recent discovery as a trawling ground, it is not considered as yet to be fully explored, but we find that the eastern part is foul, more or less, and that the north-western part is most productive, large quantities of fish, chiefly haddocks, plaice, and cod, being brought from here to the Hull and Grimsby markets. This ground has now (1881) been worked about 5 years."[1]

The Cromer Knowl, first fished on about 1858, lies north of the Leman and Dover Sands, between them and the Dowsing Bank. It has a depth varying from 12 to 18 fathoms, with generally clear bottom for trawling, on which, when first discovered, the more highly prized species of the North Sea fishes were found in abundance.

The foregoing will give a general idea of the most important North Sea trawling grounds, which, for the purposes of this report, it seems scarcely necessary to describe in greater detail.

Areas of bottom, suitable for fishing with a beam-trawl, of greater or less extent are found along the coast of the continent, near the east coast of Scotland, in the English Channel, along the west side of England,[2] and off the coasts of Wales and Ireland, but they are too numerous to mention even by name in this place. Suffice it to say that the southern and western grounds have generally been worked much longer than the majority of those in the North Sea, and in general characteristics, such as depth, kind of bottom, etc., they are like the latter, though as a rule of less extent.

The kind of fish chiefly taken on the above-mentioned grounds are turbot, sole, brill, plaice, lemon or cock sole, dabs, and halibut, of the *Pleuronectidæ*, or flat-fish family; cod, haddock, hake, ling, and whiting, of the *Gadidæ*; besides which conger eels, wolf fish, skates, gurnards, and a variety of other less important species are caught.

At first, previous to the introduction of ice for preserving fish, the grounds nearest the British coast were the only ones which could be fished on, and trawling was then carried on chiefly in the English Channel from Dover to Land's End, and along the coasts of Wales and Ireland. With improved methods for preserving the fish in a fresh condition, the smacks were enabled to venture farther in pursuit of new and richer fields for carrying on their operations. In this way they continued to discover new fishing grounds, either by accident or design, until at the present time it is pretty safe to say that there is little of the bottom of the North Sea suitable for trawling over which a beam trawl has not passed. Mr. Ansell thus describes what may be termed, perhaps, the accidental discovery of a new fishing ground some forty years ago, though it may more properly be said that this find was a happy combination of chance and enterprise, which so frequently influences the welfare of mankind:

---

[1] Fisherman's *Seamanship, by O. T. Olsen, F. R. G. S., F. R. A. S. Grimsby, 1881*, p. 103.

[2] *According to Mr. Edward Cattran, a veteran fisherman of Mount's Bay, the Plymouth and Brixham trawlers fish chiefly on what is known as the "Brixham Ground," and from there round to Mount's Bay. Off Mount's Bay, he says, sole and other species of flat-fish, with occasional ling, are taken, while "coarse fish" are chiefly caught off Brixham and Plymouth, though with the latter more or less soles and other flat-fish are taken. Hake are often found in abundance.*

"Chance brought about one of the most astonishing results in the history of the fishing trade about the year 1844, and founded the trade at Hull in consequence. One of the Ramsgate boats, in extending her searches for fish, was by adverse winds blown farther north than it was the intention of the crew, but, determined to make a try, they shot their trawl in what is now so well known as the Silver Pits, and their plucky venture and labor were rewarded by a miraculous draught of fishes, which were nearly all soles. Very soon this became noised abroad, and other boats followed, who were equally rewarded with good results."

According to Holdsworth, the Great Silver Pit was first worked over about 1843, during a severe winter.

"The Well Bank and Botany Gut [he writes] had been explored and discovered to be very productive grounds; and between them and the Dogger, and bearing nearly true east from Flamborough Head, the Admiralty chart showed a bed of deeper sounding, ranging in some parts of it from 30 to 40 fathoms; the whole extending for about 60 miles east and west and from 6 to 10 miles wide. This patch was marked the 'Outer Silver Pit,' and on trying it with a trawl, in the deeper parts at the western end and near the middle, soles were found during that very cold season in almost incredible numbers; the nets were hauled up bristling with fish trying to escape through the meshes; and such catches were made as the most experienced fishermen had never dreamed of. * * * In subsequent years the Silver Pit has again been found very productive whenever the winter has been very severe, or, as the trawlers call it, in 'Pit seasons.'"

The same author tells us, however, that "soles are generally distributed wherever there is clean sandy ground, but they are not found so much in very deep water, except during cold weather. The London market is principally supplied with this fish from the banks of the Norfolk coast and from the Channel. * * * It is rarely that any number of soles is landed at Hull. and the Grimsby shops are often supplied from London."

D. THE FISHERMEN.

The crew of a beam-trawler varies from four to seven persons on a sailing vessel, and from six to eight on a steamer. The cutters of the south of England (from Plymouth, Brixham, Ramsgate, Dover, and other ports), which vary in size from 25 to 50 tons, usually carry four persons in a crew, one or more being boys. Many of the Yarmouth vessels, if not the majority of them, have seven in a crew, but the trawlers sailing from Hull and Grimsby, and which are the largest vessels of their class, carry only five persons in a crew, as a rule, though in exceptional cases the crew-list may be larger.

The Grimsby steam-trawlers carry eight in a crew, but the smaller class of steamers do not require so many men.

In any case, a number of boys are usually carried. The Grimsby sailing-trawler generally has two boys in its crew, and sometimes the three youngest members of a crew are mere lads, varying in age from twelve to seventeen years, in which case there would be only two men on board a vessel—the captain and "second hand." Ordinarily the crew of a sailing trawler of the larger class is constituted as follows: The cook is the youngest, and is usually from twelve to sixteen years of age. The "fourth hand" or "deck hand," the next in grade, is a lad of fifteen to eighteen years of age, and generally one who has served a term at cooking. Next in rank is the "third hand," who, according to his ability and experience, may be promoted to this position when he is from seventeen to eighteen years old, and may have to hold it for lack of further promotion for several years; therefore, third hands vary in age from seventeen to twenty-seven years or more. The "second hand" occupies the position next to the master, his duty and official position corresponding with that of a mate on a merchant vessel.

The skipper completes the crew. In almost every case promotions are made from the next lower grade, and, with comparatively few exceptions, the officers of a smack have served a long apprenticeship in all the inferior grades. Of course, there is much difference in the length of time men may have to serve before rising to command, this depending on their ability, and perhaps on other circumstances.

The duties of the various members of a trawler's crew are thus defined: The cook, or, as he is sometimes called, the "fifth hand," must cook the food for all hands, and take care of the cabin and store-room, where the provisions are kept. He must learn to steer by the compass, for he must take the helm while the trawl is being shot. He must also acquire a knowledge of making and mending nets and nettles, take care of the reefing gear and keep it in its proper place, and it is his duty to coil away the trawl-warp when the trawl is being hove up. Also, he is expected, with the assistance of the "deck hand," to prepare the lights and flares for use, and to see that they are in their proper places, while the spare pump-gear and fog-signals must receive similar attention. As may be easily surmised, it is no easy task for a small boy of twelve or thirteen years of age to properly perform these various duties, particularly in rough weather, when the energies of a strong man would be severely taxed to do the work which is allotted to the cook. But it is sometimes wonderful to observe what may be done by a mere child who has been trained to the work, and we are told that these boy cooks generally perform their duties satisfactorily, though, of course, there is much less refinement in the preparation of food than on American fishing vessels, where the cook usually receives the highest pay of any one of the crew, the captain excepted, and must be a capable and active man.

The "deck hand" or "fourth hand" is generally a lad who has served as cook, and has been promoted a grade; therefore, he is supposed to be able to do all that the cook can do, besides the special duties belonging to his new position. The deck hand must know how to steer and keep a watch in fine weather when sailing or trawling. To do this, he must be able to manage a vessel under ordinary conditions of wind and weather.

"He should be able to manage a boat in fine weather, know the marks of the lead-line, and take soundings, splice small ropes and whip them, make nettles, gaskets or sennet, braid a cod-end, and learn to mend small holes in the net. He ought to tend the trawl in fine weather, keep the hold and forecastle clean and in proper order, know the sails by the marks [the sails are known by pieces of twine with knots on the end][1] in the dark, and keep them in their proper places, make thole-pins for the trawl-warp rail and boat, help to prepare fish for the market, assist the cook to trim lights, and obey all lawful commands."[2]

The "third hand" rates as an ordinary seaman, and usually has passed through the two lower grades. He should have sufficient experience to manage a vessel when her trawl is out as well as at other times, must be capable of keeping the ordinary long watches, which on a trawler may be six or eight hours on deck, and he must understand the "rules of the road," so as to avoid collision. It is required that he should learn the set of the tides, take soundings, understand how to make, mend, rig, and prepare a trawl for shooting; also it is a part of his duty to go in the boat when fish are to be "boarded" or taken to the carrier, while he is expected to have a care for the rigging, put on chafing gear, etc., besides assisting in the care of the fish.

The mate or "second hand" should be an able seaman, and be more thoroughly conversant with the general work than the third hand. It is important that he should have a very comprehensive knowledge of all that pertains to making a trawl, preparing the bridles, shooting the gear, managing the smack under all conditions of wind and weather, either sailing or fishing; while he ought to be familiar with the characteristics of the different fishing grounds, understand the tides on each, and also be proficient in the use of a sounding-lead. He is responsible for all the ship's stores, which must be kept in a proper condition for use. He should have a familiar knowledge of the buoys, beacons, light-houses, light-ships, and landmarks along the coast, and much experience in the management of a vessel under all circumstances, since, in the absence or inability of the master, the mate must take charge of the ship and carry on the work.

---

[1] This applies to the head-sails and gaff-topsails. A trawler usually carries two or three sets of top-sails of different sizes, to be used according to the strength of the wind—a jib-header in strong or fresh winds, a large square-headed sail in light winds, and frequently an intermediate size, with a short yard. As many different sizes of stay-foresails and jibs are carried, these being set as circumstances demand, while the "spare sails" are stowed away below. Frequently, of course, it is necessary to change the sails at night, and it is therefore important that the members of a smack's crew should be able to determine at once what sail they put their hands on, since this knowledge obviates much work and difficulty.

[2] Fisherman's Seamanship, by O. T. Olsen, p. 33.

"The master's duty [says Olsen], when he takes charge of a smack, is to overhaul the rigging, sails, running gear, anchors, chain, pumps, side and mast-head light, see that his compass is correct, and order his provisions, ice, and stores for the voyage.

"He must *know* the duties of every man on board, and see that every man does his duty. He must *never* forget that he is the *master*, and as such answerable to the owner. He must be able to navigate his vessel skilfully, know how to use his chart, and find his position on it by soundings taken.[1] He should be able to find the latitude by meridian altitude of the sun, work a day's work, and find the time of high water. He must be well acquainted with the *rules of the road*, lights, buoys, beacons, and dangerous shoals, where his trade lies, and know the nature of the ground for fishing. He must be an able seaman as well as a good fisherman, so that he can manage his vessel in all weathers and under all circumstances, and pick a boat up in bad weather with safety. It is his duty to see the trawl-warp properly secured to the mast when fishing, see that side and mast-head lights are properly trimmed, lit, and in their places at sundown. He should see to the icing and preparing of the fish for market and arrange them for sale in the market. He must see that the watches are properly kept at sea and at anchor, navigate the ship himself when going to sea until free of danger, and he must be ready at any moment (night or day) to come on deck when called, and use his superior knowledge in all emergencies. * * * He must act exactly as if handling his own property and not that of another man, keep his ship clean and in a seaworthy condition, and always keep a good lookout."[2]

The skipper and mate usually receive a share in the proceeds of the catch, and the third hand may be, and often is, paid a part of a share and a part in a certain stipulated sum per week, but the two younger members of the crew are hired.

---

[1] So far as I am able to judge by the observations which I had an opportunity of making, very little attention is paid to the higher branches of navigation on the trawlers. The principal dependence of the trawling skipper is on his long experience and familiarity with the soundings on the fishing grounds and along the coast, supplemented by his thorough knowledge of the set of the tides. By constant practice for years men become wonderfully expert in this peculiar kind of seamanship and navigation, and seem to reach accurate conclusions as to their position by a process which seems almost intuitive. The fishermen generally have a fair knowledge of charts, and understand the ordinary rules for keeping dead reckoning, but we were informed that observations of the sun or stars were seldom made for latitude, and we could not learn that chronometers are carried, though such may be the case in rare instances.

[2] *Fisherman's Seamanship*, etc., pp. 34, 35.

Formerly the cook and third hand were apprenticed to the master or owner of a smack for a term of years, and when their apprenticeship expired they were promoted to higher grades. This system has been much modified, if not abolished, by recent acts of Parliament, one of which, the "Merchant Seaman (payment of wages and rating) Act," of 1880, it is alleged, had a bad effect on the crews, since it took away the control which the owners had previously possessed over their apprentices. It also combined with other causes to materially decrease the number of apprentices from Grimsby and Hull, and their places were filled by inexperienced boys, taken from other trades, who frequently did not stay long enough on board the vessels to become serviceable and trustworthy. It has been put in evidence that—

"In some cases the skippers and second hands were not so efficient as formerly, though as a rule this was not the case; but the fear was generally expressed that this would steadily and rapidly increase as the existing men die out, and only men with inferior training are coming on to fill their places. * * *

"The deep-sea fisherman's vocation appears to be a specialty, which requires time and special training to master, and one not easily taken up by the average seaman, however well trained in ordinary trades."[1]

The fishermen employed in the British beam-trawl fishery are a hardy, robust class of men, and are distinguished for professional skill, bravery, and dogged perseverance; qualities which are such marked characteristics of seamen of the Anglo-Saxon race in all parts of the world. The majority of them are trained to the sea from childhood. A constant association with the perils and vicissitudes of a fisherman's life imbues them even at an early age with a sense of responsibility and fearlessness, qualifications which are necessary to their professional success. Then, too, the impressionable minds of the boys who constitute a portion of every trawler's crew soon become well stored with a knowledge of the details of fisherman's seamanship. Not only do the younger members of the crew learn the ordinary duties of a seaman, such as to "hand, reef, and steer," but they become familiar, as has been shown, with the construction and manipulation of fishing apparatus, acquire a knowledge of the different kinds of fish and their respective value, and later on secure important information relative to the fishing grounds and the seasons when fish are most abundant in special localities. All of this knowledge is, of course, of vital importance to the fisherman who aspires to success in his calling, and though the boy who begins his sea life at an early age may perhaps be deprived of many advantages that others may enjoy for obtaining a school education, it is, nevertheless, more likely that he will make a better and more successful fisherman than if he had more knowledge of books and less of his calling. Therefore, notwithstanding the system of apprenticeship which has been in vogue on the English trawlers may be open to many objections, it is nevertheless a fact, that the training which boys get under such a system is important in producing a hardy, brave, and capable class of seamen, who are specially fitted for their vocation.

---

[1] Report to the Board of Trade on the system of deep-sea trawl fishing in the North *Sea, London, 1883, p. 10.*

E. VESSELS.

The various types of vessels employed in the beam-trawl fishery, namely: steam-carriers, screw and side wheel steam-trawlers, the North Sea sailing trawler, and the single masted trawling smack (also the smack's boat) have all been described very much in detail in the chapter on fishing vessels and fishing boats of Great Britain, to which reference is made for further information as to the construction, rig, dimensions, and equipment of the British trawling fleet. Therefore, to avoid a repetition of the details, it is deemed necessary in this place to give only a general description of the various types of vessels alluded to above.[1]

The steam-carriers, employed in transporting the catch of the trawling fleets to the more important markets—London, Grimsby, and Hull—are iron, ketch-rigged, screw-steamers, designed especially for the trade. They have the reputation of being excellent sea-going vessels, and it is said that so well are the qualities of seaworthiness, capacity, and speed combined, that though they are able to make headway against heavy head winds and seas and to carry a large cargo, they nevertheless steam fast under ordinary conditions of wind and weather. Steam-carriers were first introduced in 1864, previous to which time large sailing cutters were employed for carrying the fish from the trawling fleets to the markets.

The size varies somewhat, but the following dimensions of the screw-steam carrier *Australia*, of Hull, one of the recent additions to the fleet, will give a fair idea of the proportions of the most approved type of these vessels: Length between perpendiculars, 135 feet; beam, 22 feet 6 inches; depth (to top of floors) 11 feet. (See Plate I, page 292.)

The steam-trawlers are built of iron in some localities, but in other places, particularly in Scotland, wood is used in their construction. The majority are ketch or schooner rigged screw-steamers, but a considerable number of side-wheel boats, chiefly tugs from the Tyne, are employed in trawling. The old Tyne tugs can not, in the true sense of the term, be called typical steam-trawlers, since they were designed for other purposes, and have been used for trawling only because they failed to find employment in towing shipping; a result brought about by the employment of steam screw coasting vessels and a general decline in the carrying trade from the Tyne. The steam-trawler proper came into use about 1882, two vessels having been built and set to work in that year by the Grimsby and North Sea Steam Trawling Company, which has the reputation of being the first in England to construct vessels specially for this trade; at least the first to employ steamers successfully, though it is on record that experiments had previously been made to utilize steamers for beam-trawling.

---

[1] At the time this paper was written, the author had prepared an extensive report on the fishing craft of the world, which it was expected would be published at the same time as this. The report is still in manuscript, but will probably soon be published.

There is considerable variation in the size of the steamers employed in trawling. They range from about 40 to 120 tons. Among the largest are those from Grimsby, which generally act in the double capacity of catchers and carriers. The *Zodiac*, which was the pioneer vessel of the last-mentioned class, is an iron, ketch-rigged screw-boat, 92 feet long between perpendiculars, 20 feet beam, 10 feet 6 inches depth of hold, and 192 indicated horse-power.[1] The *Granton*, a Scotch built, schooner rigged, wooden, screw steam-trawler, one of the largest and finest of her class, is 108 feet long over all, 100 feet between perpendiculars, 19 feet beam, and 10 feet depth of hold. Her nominal horse-power is 45; effective horse-power 225. She steams 11 knots, and makes 14 knots under sail and steam.[2]

A few side-wheel steamers have recently been built in Scotland specially for beam-trawlers (and for towing herring boats as well), some of the fishermen preferring this class of vessel to the screw steamers. These depend more entirely on steam-power than the propellers, and therefore have only one mast, stepped well forward, on which can be set a jib and mainsail.

As a rule, the screw steam trawlers are fine weatherly boats, and the best of them are probably not surpassed in sea-going qualities by any vessels in the world.

The North Sea sailing trawler is the most important type of vessel engaged in the beam-trawl fishery, if the numbers employed and the work it has to perform are taken into consideration.

With comparatively few exceptions these vessels are built of wood; a few iron smacks have been constructed, but they do not appear to have met with great favor, judging from the fact that their numbers have not been materially increased of late years.

The North Sea trawler is designed to secure the maximum of seaworthiness with a fair amount of speed. In the former quality it is probably not excelled by any vessel of its size in the world, and although it is comparatively light rigged ("jury rigged," as it is called by some of the English fishermen), it nevertheless oftentimes attains a moderately high rate of speed.[3] It is ketch or "dandy" rigged—the arrangement of spars and sails being specially well adapted to the work it has to perform. It ranges in size from 35 to 85 tons, though comparatively few vessels of this class are smaller than 50 tons, while many of those now being built range upwards of 70 tons. The following dimensions of the smack *Willie and Ada*, of Grimsby (in which the writer made a trip to the Dogger Bank), may be taken as a fair illustration of the proportions of the first-class North Sea trawler, though this vessel is not so deep as the majority of the class to which she belongs: Length, over all (outside of stem to outside of taffrail), 77 feet 6 inches; beam, 20 feet; width at taffrail, 12 feet; depth of hold, 10 feet; 73.68 tons. The sail area would be from 700 to 750 running yards of 24-inch canvas, and the dimensions of spars as follows: Mainmast, deck to hounds, 35 feet 3 inches, total above deck, 45 feet; maintop-mast, 33 feet; main-boom, 37 feet; main-gaff, 30 feet; main gaff-topsail yard, 17 feet; mizzen-mast, above deck, 37 feet (10 feet of this, above the eyes of the mizzen rigging, is tapered to form a pole top-mast); mizzen-boom, 19 feet 6 inches; mizzen-gaff, 14 feet; mizzen gaff-topsail yard, 8 feet; bowsprit, outside stem, 20 feet. (See Plates VII and VIII.)

---

[1] See Plates II, III, and IV, pages 294, 296, and 298.

[2] See Plate V, page 300.

[3] See Plate VI, page 302.

Of late years many improvements have been made in the equipment of the sailing trawlers, among which the most important, perhaps, is the introduction of improved apparatus for handling the trawl.

The next important type of trawling vessel is the single-masted smack or cutter, employed chiefly in the south and west of England, from Wales, and also from Ireland. These vessels are much smaller than the ketch-rigged trawlers, and seldom exceed 50 tons in size. As a rule, they adopt the "single boating" system, and it is necessary that they should be swifter than the vessels that follow "fleeting." We therefore find that the Brixham smacks, which may be taken as the type of this class, are very sharp, deep, and rather narrow, with a proportionately large spread of canvas, the form and sail area being such as to insure a high rate of speed. At the same time they have the reputation of being fine sea-boats, and there is probably not to be found in the fishing fleets of the world a higher combination of excellent sailing qualities and sea-worthiness than is possessed by some of the modern built trawling cutters of the south of England. A builder's model of one of these vessels, that was exhibited at London (1883), represented the following proportions: Length, 67 feet; beam 17.9 feet; depth, 9.7 feet; draught of water from 10 to 11 feet.

We quote from Holdsworth the following notes on the history, rig, and general equipment of the vessels employed in trawling when he wrote, which may answer very well for the present time, with the exception that the introduction of steam trawlers, iron smacks, and a few other changes which have been noted, have occurred since his report was published:

"The vessels used for trawling are commonly called smacks. During the last twenty years great improvements have been made in their design with the object of making them faster; and in some few cases it may be a question whether by the adoption of very fine lines sea-going qualities have not been to some extent sacrificed to the desire for increased speed. Formerly the smacks were much smaller than at the present time, and ranged from 23 to 36 tons N. M. They were built with the principal object of living through anything, and rarely failed to make good weather of it at all times. Many of these strong well-built vessels are still at work, and would be likely to hold their own for many more years, were it not that sea-going qualities are not the only ones required at the present day. Now, the greater demand for fish and the increased number of smacks have led to more competition among the fishermen, and time has become more valuable; for the first boats in are liable to get the best price for their fish. Most of the modern trawl-vessels are of a large size, running up to 70 tons N. M., and are fine powerful craft of upwards of 60 feet keel and good beam. They are, as formerly, built high at the bow and with plenty of sheer, making them easy and comfortable sea-boats, and whilst their increase in size enables them to use larger trawl-beams and larger nets, the general improvement in the knowledge of ship-building has led to the adoption of easier lines in their construction, resulting in the much better sailing qualities which are now required to meet the demands of the trade. The quick delivery of the fish is every day becoming a more important object, as the demand for it increases all over the country; and the smacks may daily be seen racing back to the great trawling stations to land their fish, each one endeavoring, often with the help of balloon canvas, to bring her catch early to market, where the buyers are waiting with orders to purchase for all parts of the country.

"The vessels regularly employed in trawling are, as we have said, called 'smacks,' a term which appears to have been applied to fishing boats rigged as sloops or cutters. In these smacks the mast is stepped well forward so as to allow of a large and powerful mainsail, at the same time giving plenty of room for the stowage of a long trawl-beam and large net when not at work. The rigging of these vessels was formerly rough and simple, and a long head to the mast to support the short top-mast was all that was necessary when only a small top-sail was to be set; but the large light sails now carried commonly require the addition of cross-trees and back-stays to secure the spar under the strain it has to bear. In the west country the bowsprit is without any rigging as the head-sails are small, and it is desirable to have no bobstay in the way of the trawl-warp, which, being always hauled in over the bow, has to be led thence outside clear of the rigging to one side or other of the vessel, according to which tack she is on when at work, and to be brought on board again amidships, where it is made fast to the pump-head. A large winch is fitted just before the mast for heaving in the trawl, and there is a small windlass astern, called the 'dandy wink,'[1] shipped between the head of the companion and the bulwark,[2] for hoisting up the after end of the beam when the trawl is got on board. In the North Sea trawlers the trawl-warp is worked and got in over the side by means of a patent capstan shipped near the center of the vessel. This excellent contrivance is worked by two ordinary winch-handles acting on an arrangement of rack and pinion fitted either to the top of the spindle round which the capstan turns, or to an iron standard by the side of the capstan.

---

[1] "Dandy" signifies small, and "wink" is the name applied to a windlass worked by short fixed levers instead of by movable handspikes.

[2] Since the increase in the size of the smacks of late years the relative position of the dandy wink has been changed farther aft. See description of dandy winch in another paragraph.

"The large trawl-vessels now in use from Grimsby and Hull, and recently built, are rigged in a different manner from that which has long been the general custom with the smaller craft. It was found that the increased size of the mainsail and heavy main-boom necessary for these larger vessels required more hands to manage them; and as the quantity of fish taken by these vessels did not increase in proportion to the greater size—the nets used by them being only slightly enlarged—economy and convenience were both in favor of reducing the large mainsail if it could be done without seriously diminishing the working power of the vessel. The new trawlers were therefore built of considerable length, so as to give plenty of room for a good mizzen-mast; the mast being stepped well forward to allow sufficient steering room abaft, the large unmanageable mainsail was got rid of, and the reduction in its size made up by a good-sized gaff-mizzen. These vessels can now be worked economically, and the sails, being in comparatively small pieces, are managed with only one hand more than in much smaller craft. Although these large trawlers do not bring in much more fish than the vessels perhaps 15 or 20 tons smaller—for the longest beams now in use do not exceed 50 feet—it is believed their greater cost is compensated for by the additional accommodation provided.[1] The crew have more room and increased cooking conveniences, and there is much better stowage for the ice and fish; and it speaks well both for the owners and the prosperity of the fishing trade that the men who are exposed to the hardships and dangers of the deep-sea fisheries are taken good care of by those who, having in most cases themselves gone through with the practical part of the work, are now in the happy position of owners, and can remain comfortably on shore.

"At Yarmouth, and some other places on the North Sea coast, the luggers, when not employed in herring fishing, are in some cases converted into trawlers; and, as the lug-rig is not very suitable for that mode of fishing, a temporary change is made, and they are fitted out with a different set of masts and sails; the dandy, or perhaps speaking more correctly, the ketch-rig with gaff-sails being the one adopted, the same as just described in the large modern-built trawlers at Grimsby and Hull. Some of the Ramsgate and Brixham vessels are now rigged in the same manner, and we have no doubt that it will be very generally adopted for the new vessels on various parts of the coast where deep-sea trawling is carried on, although as a rule fishermen are not fond of giving up what they have been long accustomed to. * * *

---

[1] In describing the discovery of the Great Silver Pit and its influence on the development of the trawl fishery, etc., Holdsworth writes as follows concerning changes which were made in the vessels: "At the time of the discovery of this ground the number of North Sea trawlers was very small; they were then only of about half the size of the majority of the smacks of the present day; and not enough was known of the fishing grounds to tempt the fishermen far from the land in vessels of such little power, either to face the weather they would be likely to encounter, or to seek for fish at a long distance from market. The first objection has been fairly met by the large increase in the size of the smacks; and the second has been practically removed by the great extension of railways along the coast, the employment of large, fast-sailing cutters or steamers as 'carriers' to collect and bring in the fish from the smacks."

"In 1862 a new trawler ready for sea, and what was then considered one of the larger class, could be built and fitted out for £700 or £800; but the vessels before mentioned as having recently come into use at Hull and Grimsby can not be turned out ready for work for much less than £1,200 each. This includes a fit out of all that is required for fishing, and costs about £70 or £80. A fit out consists of a double set of almost every part of the gear, to provide against accidents, and generally to save the time which would be lost if the smack were obliged to return to port before she had done a fair quantity of work. A trawl-net will perhaps last from two to four months, according to the nature of the ground worked on; but during that time parts of it will have to be renewed. The back of the net, being exposed to the least wear, lasts the longest; the under part will generally require renewing twice, and the cod five or six times, before the net is finally condemned. The cost of a new net is about £9 when made of ordinary hemp; but manilla is coming into use for this purpose, as it is very much stronger, although more costly. It is dressed with coal-tar, which preserves the material better than either Stockholm tar or tan. One of the large nets now used, and measuring about 50 feet across the square, can not be made for much less than £16.

"'Barking' the sails of fishing crafts is almost universal in this country. It consists in mopping them over with a solution of oak-bark, tar, grease, and ocher, which acts as a good preservative to the canvas; this is done every six or eight weeks, and a yard is prepared and kept for the purpose at all the important fishing stations."[1]

F. FISHING APPARATUS.

1. THE BEAM-TRAWL.

The beam trawl has been described as "a triangular, flat, purse-shaped net, with the mouth extended by a horizontal wooden beam, which is raised a short distance from the ground by means of two iron supports or heads, the upper part of the mouth being fastened to the beam, and the under portion dragging on the ground as the net is towed over the bottom." The detailed description which follows refers more particularly to the style of beam trawl used in the North Sea by the Hull and Grimsby fishermen, though, it may be stated, this has a close affinity to the trawls which are worked in the waters off Plymouth, Brixham, and other places in Great Britain.

---

[1] Deep-Sea Fishing and Fishing Boats, pp. 66–70.

(*a*). *The Beam.*

The beam is made of a length to correspond with the dimensions of the net; and the size of both the net and beam is usually adapted to the length and ability of the vessel which is to tow the trawl. The length of the trawl-beams carried by the large vessels varies from 40 to upwards of 50 feet in length, though for inshore fishing the length is, of course, not so great, ranging anywhere from 10 or 12 feet upwards. The beam is usually made of ash, beech, or elm, the latter being preferred and most commonly used; oak also is sometimes employed for this purpose, but is generally considered too heavy.[1] For the larger beams it is sometimes necessary to use two or more pieces of timber, which are scarfed and banded with iron hoops, but a single stick, if easily obtained, is generally preferred. In either case the timber is selected as nearly the proper size as possible, and little more is done to it than to remove the bark from the stick and fit the ends so that they will slip into the sockets on the beam heads, where they are securely held by iron wedges driven around the wood. A piece of timber with a slight curve in it is generally preferred by the North Sea fishermen, this being so fitted to the trawl-heads that the middle of the beam curves up and is somewhat farther from the bottom than the ends are. This is considered much better than a straight beam when fishing for haddock, hake, and other free-swimming fishes, but probably would have no advantage over the latter if sole, turbot, plaice, and other flat-fish were the chief object of pursuit.

Holdsworth says: "The length of the beam for each vessel is mainly determined by the distance between the taffrail and the after shroud, convenience and security both making it desirable to carry the beam, when not in use, hoisted up alongside, with one end projecting just beyond the stern of the vessel, where it is made fast by a special rope or chain, and the other coming in front of the after shroud or shrouds. The advantage of this arrangement is obvious, as it is generally the case that the beam has to be hoisted up whilst the vessel is rolling and pitching about in a seaway. The after end of the beam is first got into place, and the forepart is then hoisted up until level with the top of the bulwark, over which and between two of the shrouds the iron head at the end of the beam finds a snug berth, and all danger of the heavy and somewhat unmanageable spar swinging on board as the vessel lurches is avoided. It would be often difficult to prevent this if the beam were not long enough to overlap the after shrouds."[1]

---

[1] "Beech is the best wood for the purpose," according to Wilcocks, "because it is so porous, drinking up the water like a sponge, and thus becoming very heavy, which enables it to keep the ground." In trawling ports spare trawl-beams are kept on hand, and these are put where they may be soaked with water for at least several hours a day for a considerable period before they are used.

The above statement applies more particularly to the single-masted cutters, but it may be said that on the larger ketch-rigged trawlers the forward end of the beam usually comes in abaft the main rigging, and is prevented from swinging across deck by a guy rope (one end of which is fast to the after main shroud), which is taken around the head or the end of the beam by one man, who holds it firmly with a round turn on the rigging.

(*b*). *The Trawl-heads.*

The trawl heads, or head-irons, serve a variety of purposes, such as (1) weighting the trawl sufficiently to sink it; (2) supporting the beam, each end of which is firmly fixed at right angles into a socket, commonly called a "cap" or "joggle," above or below the top of the head-iron; (3) raising the upper part or back of the net, which is fastened to the beam, from the ground, thus keeping the mouth of the apparatus open sufficiently to permit the entrance of fish; (4) as a runner, which slides easily over the bottom, and to which are attached, on the front side, the towing bridles, while the foot rope and wings of the net are fastened to the rear of the trawl head.

There are several forms of head-irons used on different parts of the British coast, though those most commonly employed have a general resemblance to each other; local differences being due, in most cases, to some peculiarity which exists or has existed in the fishing from certain sections.

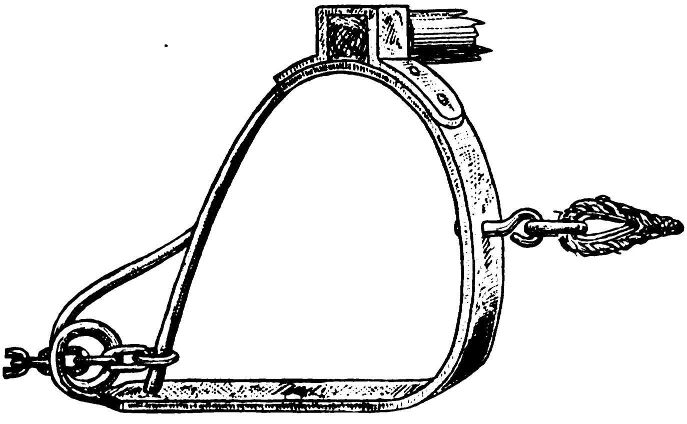


FIG. 1. TRAWL-HEAD.

From Grimsby, Hull, and other important fishing ports on the east coast of England a trawl-head like that shown in Fig. 1 is the prevailing pattern. The size and weight varies considerably, depending chiefly on the dimensions of the net, but somewhat on the judgment of the skippers using them, some believing that a heavy head-iron is preferable, while others may think one of medium weight will fish as well and is easier to handle. On the larger class of North Sea sailing trawlers they range from about 300 to 460 pounds weight for the two heads.

---

[1] Deep-Sea Fishing, etc., p. 55.

Holdsworth says: "The weight of the two irons ranges on different parts of the coast from 230 to 360 pounds, and varies generally with the size of the net and beam, as they do with the size of the vessel; but in some parts of the North Sea, where the tides are very strong, moderate-sized trawls require a great deal of weight in the head irons to keep them on the ground. It is not to the interest of the fisherman, however, to weight his trawl-beam more than enough to keep his gear at the bottom under the ordinary conditions of working."

The trawl-heads of the smack *Willie and Ada*, of Grimsby, 73.68 tons, weighed 180 pounds each, were 4 feet high, 2 feet 10 inches wide, in the broadest part, the iron of which they were made being 4 inches wide and three-fourths of an inch thick. The head-irons used on the cutter *Sobriety*, 75.29 tons, of the same port, each weighed 230 pounds.

As the North Sea trawlers catch large quantities of haddock, and more or less of other species of free-swimming fishes, it is desirable to have the beam farther from the ground than if flat-fishes were the only or chief object of pursuit; therefore the sockets into which the ends of the beam fit are placed on top of the trawl-head. Essentially the same form of head is used by the Brixham and Plymouth trawlers as that above described, these of course being somewhat lighter, as the vessels are generally smaller than those of the east coast ports; while the heavy head irons on the large vessels are perhaps generally lighter in proportion to their width than those commonly employed on the south coast. The trawl-heads are all made of wrought iron, the lower part—generally called the "sole" or the "shoe"—being of extra thickness, since this is exposed to the most wear as it slides over the bottom.

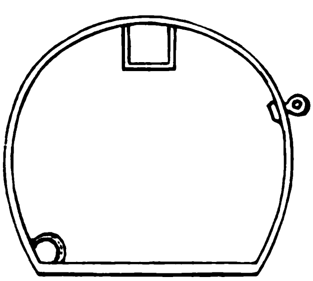


FIG. 2. BARKING PATTERN.

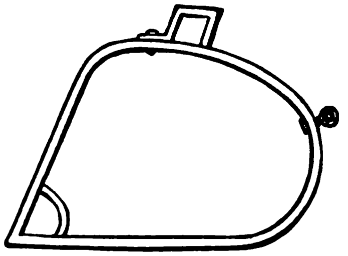


FIG. 3. TRAWL-HEAD FOR INSHORE.

The peculiar stirrup-shaped head iron, Fig. 2, known as the "Barking pattern," with its beam socket beneath instead of above the upper part, has been a long time in use by vessels belonging to the Thames. The statement has been made that "it is now generally adopted by the Yarmouth smacks, having been introduced by the Barking vessels, many of which find it convenient to make that port their station."

The small trawlers, which fish inshore near various ports of the British coast, use another form of trawl-head which is very much like that used by the Brixham men; the difference is that the iron loop through which the ground rope passes before it is made fast is put inside instead of outside of the frame, as shown in Fig. 3.

Of late years several English inventors have brought out devices for improving the head-irons. Perhaps the most noticeable of these is that invented by J. W. de Caux, Fig. 4, which was exhibited at London, and is constructed on the same principle as a Dutch pattern described in another paragraph. The trawl-head of de Caux's is wholly of iron, and consists of two strong iron plates, arranged in a triangle, joined together at the apex so as to form a socket for the end of the beam, and each having a crutch or fork at its lower end that fits over a wheel, to the hub of which the extremities of the fork is fastened by a bolt, upon which the wheel, when working, revolves. The front wheel is a little more than double the diameter of the other; they are further connected by a stout iron bar, which runs on either side from one wheel to the other, being bolted to the hub. A shackle and link for bending the trawl foot-rope to is attached to the hub of the small wheel, while a large shackle for the towing bridle is secured by a heavy bolt to the larger wheel. The wheels are broad iron bands, with four spokes in the larger and three in the small one. The special advantages claimed for this apparatus are as follows: (1) It goes upon wheels, which roll over and are not dragged through the ground; (2) The trawl-beam can be carried at any height from the ground.

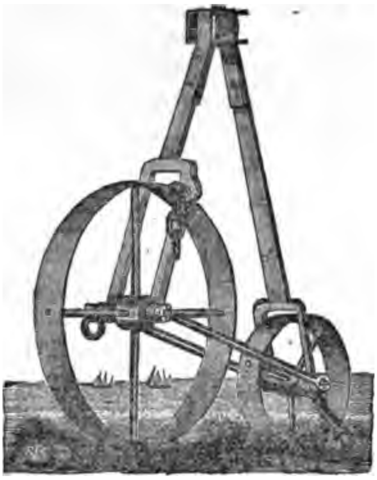


FIG. 4. DE CAUX'S TRAWL-HEAD.

Though the advantages above named are perhaps important ones, several trawl-fishermen told the writer that they were opposed to using de Caux's device, because, as they said, "it is too liable to be broken in rough weather by slapping against the vessel's side, and it's not an easy matter to repair it at sea."[1]

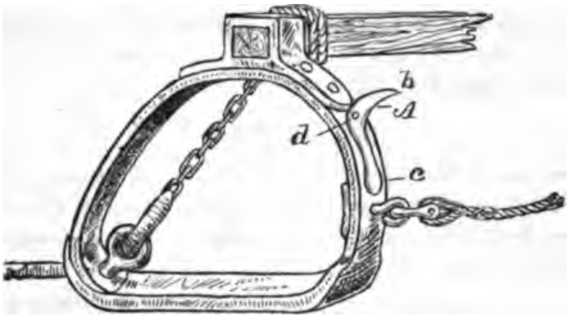


FIG. 5. SHEPHERD'S DEVICE.

H. O. W. Shepherd, of Lowestoft, exhibited at London a model of a beam-trawl, to each head of which was attached a device—shown in Fig. 5—for ascertaining when the trawl is bottom up on the ground. It was explained to the writer by Mr. Shepherd that the tides between Holland and the English coast frequently run opposite ways, setting one way at the surface and in a different direction at the bottom. This peculiar action of the currents frequently causes the trawl which a vessel is towing to be capsized without (so far as the fishermen are able to tell by the surface water) there being any apparent reason for it. Therefore, according to Mr. Shepherd, much valuable time is often lost by the fishermen, who, if using the ordinary form of trawl-head, are not able to tell whether it is upset or not; the result being that they continue to tow it without, of course, catching any fish, and they do not learn the gear is inverted until it is hove up. The head of the trawl represented by the model above referred to would have the following measurements: Greatest diameter from lower after corner to center of front (outside to outside), 2½ feet; height, ground to top of beam end, 2¼ feet; shoe or sole, 6 inches by ⅞ inch iron; front, 4½ inches by ¾ inch iron; eye to which bridle shackles, 3 inches long; diameter of eye through which foot rope passes, 4½ inches. To the upper front side of the head is attached, by a key-bolt, *d*, a movable catch, A, which has a stout, slightly curved and pointed upper end. The lower part (when the trawl-head is in its proper position) lies against the front of the head-iron, being longer and broader than the other, and also pointed or rounded, so that it will dig into the bottom like the fluke of an anchor. The purpose of this is as follows: If the trawl upsets, the point *b* of the catch, which is 4½ inches long, strikes the bottom and turns back, moving on the pin *d*, until it rests against the upper part of the head iron. This movement causes the point *c* of the device to stand out at right angles with the head-iron, and as the trawl is dragged along over the ground this point sticks into the bottom, and either stops the progress of the vessel or causes the apparatus to have a sort of jerky motion, which indicates to the fisherman that his gear is capsized; he therefore proceeds at once to get it into proper position for fishing.

---

[1] Mr. Sims, a veteran fisherman and smack-owner of Hull, in discussing the paper on trawling read by Mr. Ansell, said he "did not see any difference in the shape of the trawl now from what it was fifty years since, and the only difference was that it was extended in size."

(*c*). *The Trawl-Net.*

That portion of the apparatus to which the term "trawl" is more especially applied is the net. It is formed of several sections, each of which has a technical name, there being, however, local differences as to the terms applied.

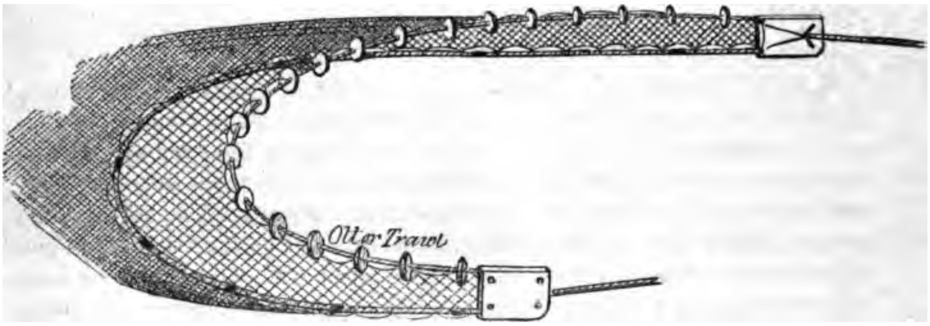


FIG. 6.

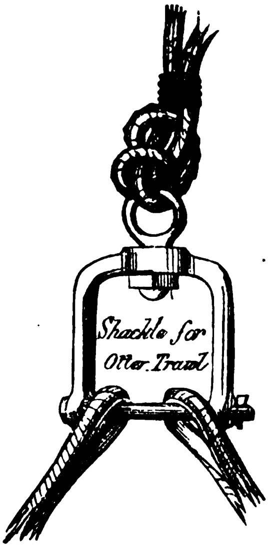


FIG. 7.

There are other kinds of trawl-nets, such, for instance, as the otter trawl (Figs. 6 and 7), which do not have a beam.

Holdsworth states that "the differences between them relate to the appliances in use for its effective working rather than to the principle of its construction or the object for which it is to be employed. In all cases it has the general form of a triangular bag or purse, and the variations in shape or fittings are due to the different plans adopted for insuring the mouth of the bag being kept open, so that the fish may enter whilst the net or bag itself is towed along out of sight at the bottom."

As has been stated, the trawl is triangular in form, and if one can imagine an elongated flat-iron-shaped purse lying on the ground, with the upper part of its mouth slightly raised and straight and the lower part very much hollowed out, so as to form a deep curve, he will have, perhaps, a fair idea of a trawl-net. The upper surface of the net is called the "back," and the underneath part, which rests on the ground, is termed the "belly." The several sections of which the back and belly are composed are made separately, after which they are joined together to form the net. They are known by the names of the "square," "baitings" "batings" or "upper," "wings" or "gorings," "belly" or "ground," and "cod" or "cod-end." The "square" is the front upper portion of the net; its straight edge is fastened to the beam, and it is usually about one-half the length of the whole trawl. The section called the "baitings"[1] is also on the upper surface of the trawl, and is joined on one side to the square and on the other to the cod-end. The lower part of the trawl corresponding to the square is "cut away in such a manner that the margin forms a deep curve below, extending from one trawl-head to the other, close to the ground, and with the center of the curve or bosom at some distance behind the beam and front of the net. The usual rule for the depth of the curve is that the distance from the beam to the bosom should be equal to the length of the beam. In French trawls it is very much less. There is, however, in all cases a considerable space of ground over which the beam and back of the net must pass before the fish lying on the bottom are disturbed by the under part of the net. The Yarmouth trawlers use a beam about 36 feet in length, and a much shorter ground rope in proportion than is employed by the Brixham and Grimsby fishermen; there being an idea on their part that when working in strong tides on the Dogger Bank the large-mouthed nets are liable to close up; a difficulty, however, which does not appear to have been discovered by the fishermen from other ports.

We were told by the Grimsby fishermen that trawls rigged chiefly for catching soles have foot ropes about four-fifths as long as those for general fishing.

---

[1] The portion of the trawl called the "baitings" by the Grimsby fishermen is known to the trawlers in the south of England as the "upper," according to statements made to the writer by Grimsby smackmen, while the sections which the latter term the "belly" and "wings" are, they say, designated the "ground" and "gorings" by the Brixham and Plymouth men.

"Each fisherman has his own fancy as to the fixing of the trawl in his own particular way in order to make more or less *bosom* to the trawl.

"The narrow, straight sides of the net between the back and the ground rope, and extending from the trawl-heads to nearly on a level with the bosom, are called the 'wings' or 'gorings'; they are generally made of separate pieces of net, and are inserted when the several parts composing the net are put together."

The lower portion of the net immediately beneath the baitings, and of similar size and shape, is called the belly or ground.

"From the bosom the whole net, now forming a complete bag, tapers to the cod or purse a length equal to about two-thirds of that of the beam. The cod is a narrow bag, about one-seventh of the entire length of the trawl; it is that part of the net into which all the fish which pass over the ground rope sooner or later find their way, and in which most of them are collected when the net is hauled in. The extremity or 'cod-end' is closed by the draw rope or 'cod-line,'[1] which gathers the end of the net together and prevents the escape of the fish until it is got on board, when the rope is cast off, the cod-end opened, and the fish fall out. The under part of the cod having a good deal of the weight of the fish on it, is of course exposed to a great deal of wear and tear as it is dragged over the ground; so, to protect it from chafing and being destroyed, old pieces of net, termed 'rubbing pieces' or 'false bellies,' are fastened across it in such a manner as to overlap one another successively from one end of the cod to the other, and thus to relieve the strain on the net itself. * * *

"Just above the entrance to the cod the 'pockets' are placed, one on each side of the interior of the main portion of the net. They are not separate parts of the net, but are made by simply lacing together the back and belly for a length of about 16 feet, in a line from the outer edge of the bag downwards and inwards to its small end and the commencement of the cod. This part of the bag is therefore divided into three spaces, and of nearly equal breadth at the lower end, those at the sides being the pockets, and the central space that through which the fish must pass on their way from the entrance of the net to the cod or general receptacle. This passage between the pockets is guarded by a veil of netting, called the 'flapper,' fastened to the upper part or back, and with its free edge directed towards the cod, so that the fish can easily make their way under it into that part of the net, but not so readily return. The mouths of the pockets face and open into the cod or end of the net where the fish are collected, and there being no means of escape for the fish at the cod-end, many of them, and especially the soles, work their way along the sides of the cod into the pockets, continuing their progress in that direction till they are stopped by the gradual narrowing and termination of the long funnel-shaped inclosures."[1]

---

[1] This is called the "poke-line" by Grimsby fishermen, the term cod-line being applied to a piece of rope extending from the forward end of the beam to the cod-end.

The several sections of the net having been joined together, the front edge of the square is hung to a 2¼ to 2½ inch manilla rope, called the "head rope," which is fastened to the beam at each end, and generally in three other places at equal distances on the beam. The end of the head rope that fastens to the after end of the beam, that is, the end of the beam which is aft when the trawl is on the vessel's rail, has a piece of chain 4 or 5 feet long attached to it; this is used to make fast to the trawl-head; and chain is preferred, since it can not be chafed by the dandy bridle. The "foot" of the net—that part which fastens to the foot rope—is first hung to a small manilla rope (about 1¼ inches in circumference), called the "balch-line," which is a little longer than the foot rope, to which it is seized with marline, the seizings being put on a foot apart on the wings and about half that distance in the "bosom," as the middle of the curve formed by the foot rope is called.

The foot rope is generally made of old towing hawser, which on the large smacks from Grimsby is about 7½ inches in circumference. This is unlaid and laid up the opposite way, so that it will be more flexible. It is served or "rounded" from end to end with small rope, say from 2 to 2½ inches, this being, like the hawser, partly worn. This rounding is put on for the double purpose of (1) increasing the size of the foot rope, and thereby making it heavier, so that it will lie close to the bottom, while, being large, it is easier to drag along without "digging" into the ground; and (2) for preventing the chafe to which it otherwise must be exposed. The rounding is generally put on by machinery, since it is difficult to get it on properly by hand.

The trawlers that fish principally for soles generally put a piece of chain 15 to 20 feet long in the middle of the foot rope, or else weight it with lead, to make it "bite" the ground; otherwise the soles would escape beneath it, as they lie so close to the bottom—often partially covered with sand or mud. When chain is used, it is first wound around with old net until it is made as large as the rest of the foot rope, when the whole is served with small stuff in the manner already described. To each end of the ground rope, and forming part of it, is attached a piece of chain, which is long enough to fasten around the trawl-head. In the trawling apparatus invented by de Caux the ground rope is fitted with rollers (Fig. 8), which, it is claimed, facilitate its progress over the bottom.

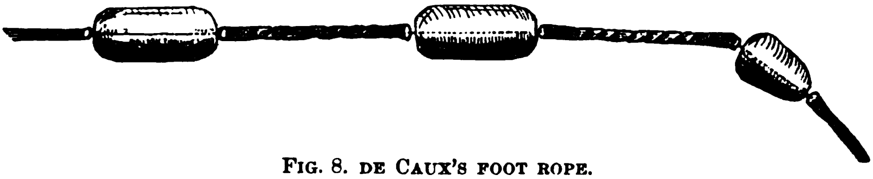


FIG. 8. DE CAUX'S FOOT ROPE.

---

[1] Deep-Sea Fishing, etc., pp. 60-62.

"The ends of the ground rope are made fast on each side by a few turns round the back of the trawl-head just above the shoe, and the rope rests on the ground throughout the entire curve; the fish, therefore, have no chance of escape at either the sides or bosom of the net, and their only outlet, when once the beam has passed over them is in front, so that they must dart forward in the direction in which the net is moving to enable them to get clear of it. The object of making the ground rope of old material is that it may break in case of getting foul of rocks or any chance obstruction which may be met with on the generally smooth ground, where a trawl can only be worked with advantage. If in such contingency the ground rope were strong and good, the least mischief likely to ensue would be anchoring of the vessel by her trawl, involving great loss of time in clearing it, and resulting probably in breaking the beam, and other damage; but as these nets are used in deep water, where there is always more or less sea or swell, the great danger to be feared when the net gets foul is the parting of the warp by which the trawl is towed, and the consequent loss of the whole gear. If, however, the ground rope give way, the only damage likely to result is in the under part of the net behind it being torn open; the whole apparatus then comes away clear, when it can be hoisted up overhauled, and the netting and rope repaired. It was formerly the custom to weight the ground rope to insure its close working over the bottom, and it is still sometimes the practice at Yarmouth to use short lengths of chain for that purpose, secured at each end by rope-yarns to the ground rope, so as to be easily torn away in case of getting foul. The French trawlers also use chain on the ground rope, but in those we have examined a great length of chain has been suspended in short festoons and secured by iron rings over the rope, and therefore not easily detached. Our west-country fishermen find that by giving a large sweep to the ground rope an old hawser is heavy enough without other addition than the small rope with which it is covered or rounded."[1]

The cod-end of a trawl-net (at least such as are used on the large smacks from Grimsby) is made of double twine, and the meshes are smaller than in the other sections of the apparatus, which are made of single twine. Four sizes of meshes are used in the large trawl-nets, increasing from 1½ inches at the cod-end to 4 inches in the back, while the underneath part of the net is generally made of twine a size larger than is used for the back.[2]

The material used in the construction of the net is small manilla stuff about the size of marline, and essentially the same as the "lobster-twine" that New England fishermen employ for a number of purposes. The nets are coated with coal tar.

A piece of old rope, say 2½ to 3 inches in size, called the "cod-line" by the Grimsby fishermen, somewhat longer than the trawl, and having an eye-splice in one end, is used to haul up the cod-end when it is heavily weighted with fish, or when, as sometimes happens, it contains stones of considerable size. When either of these contingencies occur it is difficult, especially in rough weather, to pull the net over the smack's side with a heavy weight in the cod-end dragging down. One end of the cod-line is secured to the lower end of the net by the "poke-line" with which the cod is tied up, while its other end makes fast to the forward trawl-head.

---

[1] Deep-Sea Fishing, etc., pp. 59-60.

[2] "The size mesh of the trawl," writes Ansell, "is much smaller as we go south of Yarmouth. About Hull the mesh is about 3¼ inches square down to 1¼ inches."

(*d*). *The Trawl-Warp and Bridles.*

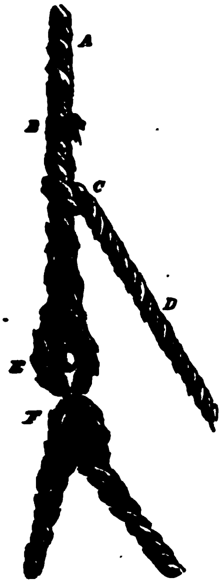


FIG. 9.

The trawl is operated or towed over the bottom by what is called a "trawl-warp" (A, in Fig. 9), usually a 6 to 7½ inch hemp or tarred manilla hawser 150 fathoms long, two strings of 75 fathoms each being spliced together to form it. One end of this, in which is an eye-splice and thimble (E, Fig. 9), is shackled to two other pieces of smaller hawser, termed the "bridles" or "spans" (F, Fig. 9), each of which is 15 to 20 fathoms long. These lead one to either side of the trawl's mouth, where they are shackled to the swivel eye-bolts in front of the trawl-heads.

A smaller but somewhat longer rope, having a piece of chain at its lower end, is called the "dandy bridle" (D, Fig. 9). This is made fast permanently to that end of the beam which comes aft when it is taken on the rail, three or four turns of the chain on its end being taken around the beam; the extreme end is shackled to the trawl-head or to the standing part of the bridle. The other end is secured to the trawl-warp just above where the bridles shackle on, by a half-hitch (C), with the end stopped back (B, Fig. 9).

The dandy bridle is used for convenience in heaving up and securing the after end of the beam to the stern of the vessel, its use preventing the necessity of rigging a derrick, as otherwise it is usually necessary to do. At present, however, the dandy bridle is quite generally adopted on the larger class of vessels.

(*e*). *Dimensions and Method of Construction.*

As a matter of interest, in this connection I give detailed measurements of the trawls of two Grimsby smacks, the *Willie and Ada*, of 73.68 tons, and the *Sobriety*, of 75.29 tons, The following are the dimensions of the trawl of the *Willie and Ada*:

Length of beam	feet	46
Diameter of beam	inches	8
Weight of heads, each	pounds	180
Height of heads from ground	feet	4
Breadth across widest part	feet	2 10/12
Width of iron	inches	4
Thickness of iron	inch	¾
Foot rope, length	feet	98
Foot rope, size	inches	7½
Length of chain on each end of foot rope	feet	6
Size of rope with which foot rope is served	inches	2½
Size of head rope	inches	2½
Length of head rope, including chain at one end and allowing enough to make fast at each end	feet	52
Length of balch-line, including 9 feet at each end to reach from the foot rope to beam and fasten	feet	126
Whole length of trawl-net from beam to end	feet	84
Length of square from beam to baitings	feet	42
Length of baitings and belly, each	feet	30
Length of cod-end	feet	12
Width of opening at lower part of cod-end	feet	4
Length of "poke-line" used for tying up cod-end	feet	15
Size of "poke-line," (manilla rope)	inch	2½
Length of "cod-line," (a rope leading from the lower part of the net to the forward end of the beam, generally old rope, and used for hauling the bottom of the net alongside when it is full of fish)	feet	96
Length of towing hawser (size, 7½ inches)	fathoms	150
Length of dandy bridle, not including chain on end	fathoms	21
Length of chain on end of dandy bridle	feet	9
Length of forward and after bridles (6-inch hawser), each	fathoms	20

The measurements of the trawl on board of the cutter *Sobriety* compared very nearly with the above, the principal difference being in beam, foot rope, and weight of the heads, the height of the latter being the same. The following will show the differences:

Length of beam	feet	48
Diameter of beam	inches	9
Length of foot rope	feet	94
Length of balch-line	feet	132
Weight of trawl-heads, each	pounds	230

The following are additional details of the construction and equipment of a beam-trawl of the size mentioned above:

In making the net, from 200 to 220 meshes are "set up" for the head of the "square," and from 190 to 200 meshes at the bottom. The baitings or "batings," which are joined to the square, are "set up" with the same number of meshes as the bottom of the square, either 190 or 200, and are "braided down" to 50 meshes, with 10 or 12 feet cod-end added.

The "ground" or "belly" is made the same as the baitings.

The wings would be about 43 feet long. They would be "set up" at

190 to 200 meshes, according to Olsen, with 55 in each wing. The remaining meshes form the bosom, and are braided down to 30 at the ends.[1]

The "flapper" should be "set up" at 40 meshes, and tapered to 20 meshes at its end. This, as has been explained, is fastened to the back of the trawl-net, and so arranged by lacing it in a line with the pockets that it will drop down and close the entrance to the cod-end when the apparatus is not moving through the water.

Olsen gives the following directions for putting together the several sections of a trawl-net and preparing it to bend to the beam and heads:

"I would first count the meshes in the lower part of the square and upper part of the batings; if they correspond, join them together. Next, I would count the meshes in the belly and wings, and join them together; then I would stretch the net along the deck, with the cod-end aft, and put the lower batings of back and belly together, make fast to a spar lashed across the deck, pull taut both belly and batings, and make them fast forward, then lace the trawl from the lower end upwards. Now I would stretch the wings and square forward, and lace from the head downward.

"I would [then] take the turns out of the balch-line, then balch the wings by finding the middle mesh of the bosom or center of the wings, and clove-hitch them onto the balch-line, so as to make the spaces a little larger than the mesh. I next stretch the ground rope along the deck and take the turns out, lay the bight aft and the ends forward, measure it and tie the center mesh of the wings, then lash the bight of the ground rope, set up taut with a tackle from forward, and keep the ground rope up from the deck by placing a spar across the deck. Now I would measure the bosom and tie up to the quarter, pull up the square from quarter to head, allowing 3 or 4 feet for shrinking, tie up the balch-line and complete the roping."

To put in the flapper and pockets he would join the former "on at 80 meshes under the back, lace the salvage to the belly—the flapper being 40 meshes, leaves 20 meshes on each side of the salvage—then I would lace up the pockets in a line with the flapper."[2]

The lower part of the cod-end must then be provided with "chafers"—pieces of old net, or some other material, lashed on to prevent the bottom of the trawl from being too quickly worn out by chafing on the ground.

For rigging up the beam, bridles, etc., 6 iron wedges are required for wedging the ends of the beam into the trawl-heads; 2 trawl-warp and 4 bridle-thimbles; 1 dandy-chain shackle, 2 main-bridle shackles, and 2 trawl-warp shackles.

Various devices have been invented, besides those already mentioned, for improving the beam-trawl; most of these, however, being for the purpose of allowing small fish to escape from the cod-end. Among other advantages claimed by de Caux for improvements were the following:

---

[1] Fisherman's Seamanship, p. 28.

[2] *Ib.*, pp. 28-29.

1. Inside the trawl-net a smaller net is fixed so as to form a funnel to prevent the escape of large fishes.
2. The cod-end of the net is made so that when fishing the meshes are kept widely open to allow small fishes to escape therefrom.
3. At pleasure the net can be disconnected from the trawl-beam and the wheels at the bottom of the sea, and can be shut up and brought to the surface separately from them.

Whatever practical value these improvements have I am not prepared to say; the fact remains, however, that the common form of trawl is still almost exclusively in use. One inventor has an arrangement of frames, flat on the bottom and curved on top, over which the cod-end is drawn in such a way that the meshes are kept distended. Another proposes to accomplish the same result—namely; to allow the small fish to escape—by having a number of rubber grommets put here and there in the cod-end, these being sufficiently large to permit the small fry to pass through; and still another device consists in having the cod-end distended with larger hoops, the mesh much enlarged, and the lower part provided with an apron to prevent chafe on the bottom.

2. Apparatus for Operating the Trawl.

In order that the manipulation of the beam-trawl may be more fully and clearly understood, it seems desirable that the various kinds of apparatus which have been devised especially for the purpose of handling it should be described in considerable detail. Though these form a portion of the vessel's equipment, and have been alluded to in a general way in that connection, still the various implements used in working a

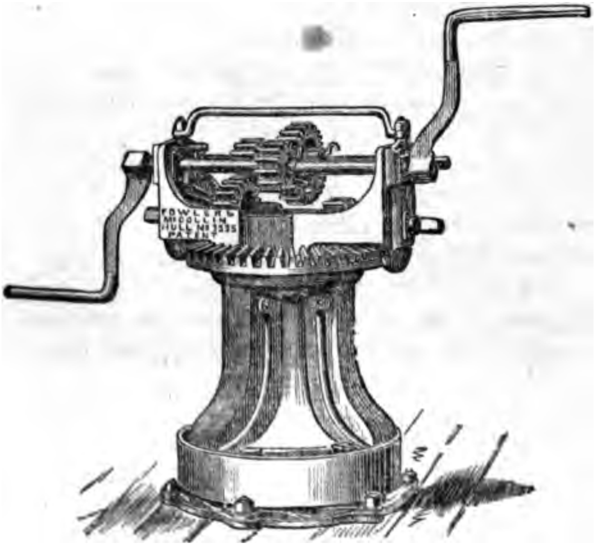


FIG. 10. AN EARLY TYPE OF CAPSTAN.

beam-trawl are almost as much a part of the apparatus as the trawl itself, and the successful prosecution of the fishery has, perhaps, been more dependent upon improved appliances for manipulating the gear than on anything else. The descriptions which follow are based chiefly on a study of the two Grimsby smacks upon which I sailed and which subsequent investigation has shown to be fair representatives of their class.

(*a*). *The Capstan.*

Several forms of hand-power capstans have been used for working the beam-trawl. The increase in the size of the vessels and fishing apparatus has not, as a rule, been followed by an increase in the number of men constituting a smack's crew, and as, of course, greater power is required to heave up the large trawls now in use, this has to be supplied by improved capstans, which are so constructed by a system of cog-wheels and ratchets (see Fig. 11), that as many as four different purchases can be obtained on some of them, the first being a very quick motion for pulling in slack warp; the fourth, a slow but most powerful one for a very heavy pull, while the others are intermediate; various degrees of power and quickness being thus combined in the same implement.

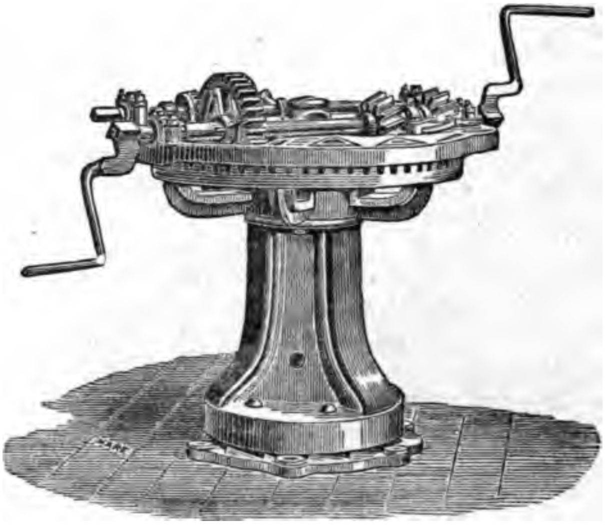


FIG. 11. AN IMPROVED CAPSTAN.

The necessity which exists for having increased facilities to raise the trawl from the bottom has led to the introduction, of late, of steam as a motive power for working the capstan, which is generally so made that it can be worked by hand as well, in case anything should make it impracticable to use steam. A vertical boiler and vertical engine are most commonly, if not exclusively, used, and the whole is made as simple as possible, in order that it may be managed by the fishermen with very little trouble. (See Plate XIII.) Steam capstans were first used on sailing trawlers in 1864, when the firm of Fowler & McCollin, of Hull, fitted one on the smack *Monarch*. This firm was succeeded by the Vulcan Iron Works Company, Limited, which company, according to Mr. Charles Hellyer, a smack-owner of that place, now manufacture the most approved form of apparatus of this kind. This arrangement consists of a vertical steam-engine, fitted with two cylinders, each 4½ inches diameter, 8-inch stroke, fixed on a strong standard, independent of the boiler, and equipped with patent high-speed governor and throttle-valve, improved stop-valve, treble-valve, force-pump, etc. The boiler is vertical also, with cross-tubes in the fire-box, lagged and cased, and provided with a full set of mountings and fittings, consisting of double safety-valve, steam pressure-gauge, two water-gauges, blow-off cock, chimney, and deck casing. The gearing consists of horizontal and vertical shafting, with the necessary foot-step and bearing, friction-clutch, bevel-wheel and pinion, and spur-pinion working into spur ring-wheel on capstan bottom. The friction apparatus is so arranged that it can readily be thrown in and out of gear by means of a lever on deck or in cabin companion.

Mr. George R. Dunell gives the following additional particulars, in (London) Engineering, July 27, 1883, concerning the use of steam on trawling smacks:

"Steam gear is fitted on most vessels of this kind for the purpose of handling the heavy trawl used in modern times. The machinery on the *Frank Buckland* consists of a vertical boiler and a pair of inverted vertical non-condensing engines.[1] The boilers generally used for this purpose are from 2 feet 9 inches to 3 feet in diameter and 6½ to 7½ feet high. They have only one or two cross-tubes, all parts having to be as simple and accessible as possible, for frequently the attendance is not that of a highly-skilled operator, although some smacks carry a properly-trained engineer attendant. The diameter of the cylinders is 5 to 6 inches and the stroke about 10 to 12 inches; the steam pressure ranges between 50 and 65 pounds. The price of such an engine and boiler complete (but exclusive of water-tank) is from £125 to £145. Most of the trawlers carry a tank for fresh water holding 800 to 1,200 gallons, but Mr. Alward thinks this an unnecessary refinement. Probably, with a properly-instructed and careful engineer on board, who will 'blow off' at intervals, and considering the simple nature of the boilers, salt water would answer very well for feed, and the room that would be occupied by the fresh-water tanks could be better utilized."

(*b*). *The Dandy Winch or Wink.*

Holdsworth has described the "dandy wink" as "being shipped between the head of the companion and the bulwark," and this description no doubt applied well enough to the Plymouth and Brixham trawlers at the time he wrote.

On the larger ketch-rigged vessels it is placed some 10 or 12 feet aft of the companion, and generally almost directly abreast of the mizzenmast. A strong bitt-head, firmly secured to the deck by a knee on its after side—similar in shape to an ordinary windlass bitt—serves as a support for one end of the dandy wink, and the gearing by which it is worked, while an iron spindle in the opposite end fits into a socket on the rail, to which is also secured a dog or pawl which, dropping into an iron ratchet on the end of the wink, prevents the latter from turning back. (See Fig. 12.) The arrangement of cog-wheel work on this winch is such that two purchases can be obtained, one giving a rapid motion to the barrel of the winch, and the other, but more powerful purchase, turning it slower. It has already been explained that this is used to heave up the after end of the beam by means of the dandy bridle.

---

[1] A fine model of this smack was exhibited at the International Fisheries Exhibition at London by Messrs. Alward & Eskritt, of Grimsby.

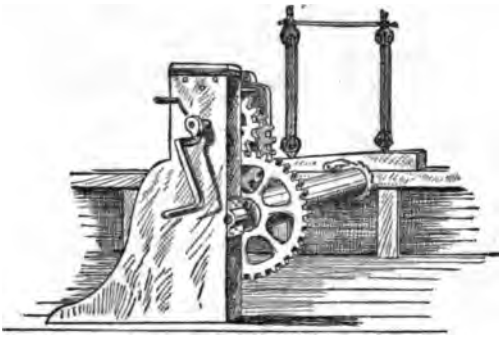


FIG. 12. THE DANDY WINK.

(c). *The Forward Winch.*

Another winch, which is used in handling the trawl, stands about half way between the windlass and mainmast on the larger ketch-rigged trawlers. This is worked, like the others, with a crank—one on each end if necessary. It is supported by two bitts, which are from 3½ to 4 feet high. On the starboard end is a large cog-wheel, into which plays a smaller cog-wheel on a shaft that is secured to the forward side of the bitts. If only a small power is required the wheels are uncoupled and the crank shipped on the shaft to which the power is to be applied.

(d). *The Dummy.*

Some 4 or 5 feet forward of the companion, and almost exactly in the center of the deck—either way—stands a large round post, some 3 feet high, called a "dummy." (See Fig. 13.) This has four or more "whelps" on it, and the trawl-warp is veered around it when the trawl is being shot, and to this stanchion, too, the warp is fastened while the gear is out and being towed over the ground.

(e). *The Trawl-Warp Roller.*

Fixed between two stanchions, on the port side of a trawler, and directly abreast of the capstan, is a large iron roller (see Fig. 14) for the trawl-warp to pass over when it is being hove in. This is provided with ratchets on the forward end, into which a pawl falls to prevent its turning back.

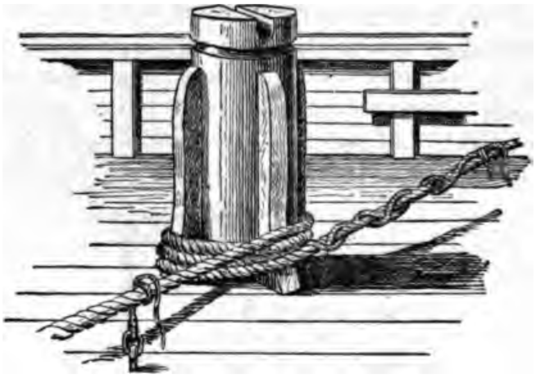


FIG. 13. THE DUMMY.

The trawl-roller of a vessel of 70 to 75 tons will be 14½ inches long, 11 inches diameter at the ends, 7 inches diameter in the center. The rail is fixed so that it will turn back on a hinge, and a piece of bulwark is made to fit in snugly over the roller when it is not in use, but is, of course, removed whenever the trawl-warp is hove in. (See Fig. 15.)

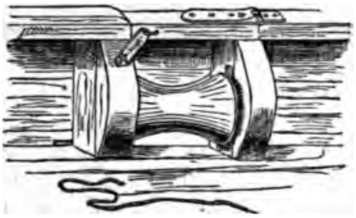


FIG. 14. TRAWL-WARP ROLLER.

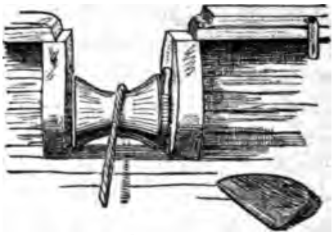


FIG. 15. ROLLER IN USE.

On the single-masted trawlers at Brixham and Plymouth the trawl-warp roller, which is much shorter, is placed on the port side of the stem-head.

(f). Dandy Bridle Chock.

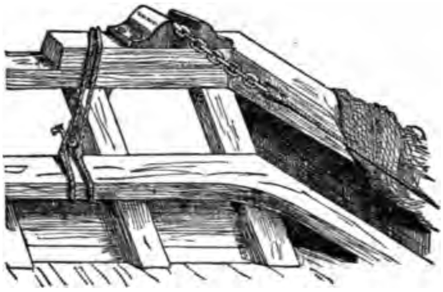


FIG. 16.

A large iron chock, with a roller fitted into it (see Fig. 16), is secured to the port side of the taffrail. When the after end of the trawl is being hove up the dandy bridle is taken in through this chock and thence to the dandy winch.

(*g*). *Fish Tackle.*

A heavy purchase tackle is used for hoisting in the cod-end of the trawl. The upper block of this tackle is usually threefold, and hooks somewhere about the mainmast head or beneath the cross-trees; the lower block is double or treble; the fall is 2½ to 2¾ inch manilla rope. When the lower block has been hooked into the strap that is put around the cod-end, the end of the fish tackle fall is usually rove through a snatch-block hooked near the foot of the mainmast, and taken thence to the forward winch.

3. APPARATUS FOR PACKING FISH, ETC.

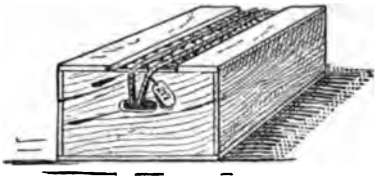


FIG. 17.

(*a*). *Fish Boxes.*

All of the trawlers which fish in fleets in the North Sea use oblong wooden boxes, generally called "trunks" (see Fig. 17), to pack their fish in. These are of uniform size, and hold from 85 to 95 pounds of fish, the difference in weight depending chiefly on the kind of fish; some species of flat fish—the sole, for instance—pack very closely, and consequently weigh more than a box of haddock or cod. The boxes are partly covered by a strip of board nailed on each side of the top, while an oblong hole, large enough for a man to get his hand in, is cut near the upper edge of each end. In handling the boxes after they are filled these holes are very convenient, as they afford a hand hold, and they are also of service for reeving through the line which runs from end to end of a box to hold the fish in position.

The Brixham trawlers, who carry their fish to market every day, or perhaps twice a day, use small baskets, called "pads" and "half-pads."

Holdsworth says: "The packages in which the trawl-fish are stored have lost much of their significance as denoting any particular capacity. Pads and half-pads were once recognized measures, and are still spoken of in some of the markets, although the quantity of fish contained in them is rather uncertain. Ten years ago [about 1864] they were the only packages used by the Hull and Grimsby trawlers. The 'pad' consisted of three 'pots,' and the 'half-pad' of two pots of fish. This division of a package into three or two imaginary parts called 'pots,' was for the convenience of the salesman and buyers; for instance, if two pads and three half-pads were to be sold, they were offered as twelve pots; fish were said to be worth so much per pot one day, and so much another day. This measurement was also found very convenient by the fisherman, as in case they had not enough prime fish at the end of their packing to fill a half-pad they still put it into a half-pad basket and called it a pot. At one time pot baskets were used, but they have been long given up. Formerly speculative dealers used to bargain with some of the fishermen to take all their prime fish at so much per pot, and then a pot was to weigh 40 pounds; but a half-pad (two pots) subsequently came to weigh from 80 to 120 pounds, the difference being caused by the fish being more or less piled up on the top of the basket. A further change was made by the introduction of wooden boxes called 'trunks,' and they were used especially for the package of soles, a trunk or box of soles usually containing from sixty to seventy pairs, weighing about 100 pounds.[1] Plaice and haddocks are also packed in them, about forty of the latter, when sold for the fresh market, going to the 'box.'"

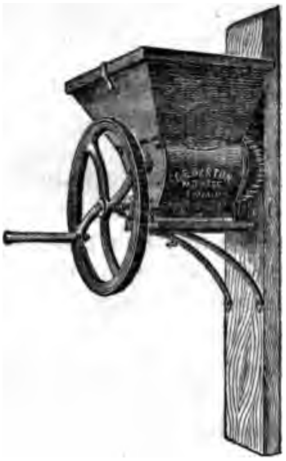


FIG. 18.

(*b*). *Ice Mill.*

Most of the North Sea trawling vessels, especially those which go "single boating" a portion of the year, carry an ice mill which is used for grinding up the ice that the fish are packed in. This mill is generally secured to a bulkhead in the ice-house below deck. It has three revolving barrels fitted with strong steel teeth and is operated by a crank-wheel, which, by a system of connecting cog-wheels, causes the barrels inside to turn in such a way that the ice is broken or picked up fine enough for use.

---

[1] The more general adoption of the wooden box called the "trunk," as a package for all kinds of fish on trawlers, is probably due to the system of "fleeting," since these boxes are more readily handled and stowed than baskets could be under like conditions.

(c). *Boats.*

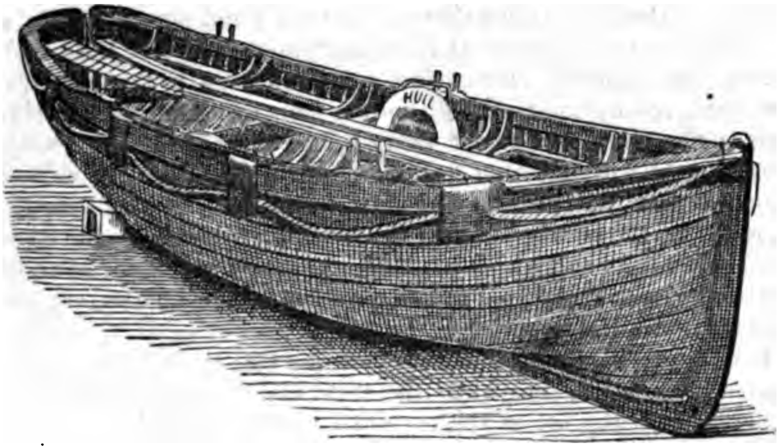


FIG. 19.—A TRAWLER'S BOAT.

The boat (see Fig. 19) used on the trawlers for transporting the fish from the catcher to the carrier is an open, clinker built, keel craft, wide, and rather clumsy looking, with full rounding bow and heavy square stern. It is strongly built, and has a large carrying capacity. The boats carried on the larger trawlers are about 17 feet long, 6½ to 7 feet wide, and 2 feet 9 inches deep.

The dangerous work performed by these boats is detailed elsewhere, but it may be said here that, because they are frequently capsized and the men in them drowned, an effort has been made to provide them with some kind of suitable appliance which may render them unsinkable and insure the greater safety of their crews. Many devices for attaining this much-desired end were shown at the London Fisheries Exhibition, in 1883, but none of them met with the full approval of the examining jury.

(d). *Doddle Net or Diddle Net.*

A dip-net, called a "doddle" or "diddle" net, forms part of the equipment of a trawler, and is used to dip fish out of the trawl when an unusually large catch has been made and the weight of fish in the net is too heavy to hoist in. At such times a hole is cut in the back of the trawl and enough fish removed with the dip-net to lighten it; on some extraordinary occasion perhaps two or more holes have to be made in the net. The doddle net resembles the dip-net used by the New England mackerel seiners, though it is not quite so large as the latter.

G. METHODS OF FISHING.

1. GENERAL DESCRIPTION OF THE USE OF A BEAM-TRAWL.

To obtain the greatest success in trawling one condition is especially desirable—that of having a moderately strong and favorable tide, since the trawl is always towed as nearly as practicable with the set of the current, but somewhat faster, as it will then work to the best advantage, being easily kept on the bottom over which it passes steadily. This is necessary, for the net being lighter than the beam (loaded as the latter is with the iron heads), would otherwise be liable to drift forwards and thus prevent the entrance of fish. A moderate excess of speed in the trawl over the tide, varying according to the strength of the wind from half a knot to about a knot and a half per hour, keeps the net expanded and in a proper position on the bottom, so that the best results can be secured.[1]

It is, perhaps, most desirable to have the tide setting nearly at right angles to the wind, since then the trawl can be towed equally well on either tack as the set of the current changes with the ebb or flood. As, however, the tides run as frequently to leeward, or to windward, as in any other way, much care and skill is necessary to work the trawl to the best advantage, so that it will keep the ground, will pass over the bottom as fast as is necessary, and also not be upset. It may be explained here that, with a weather tide, the vessel is (or should be) put on whichever tack will permit her to tow the trawl as nearly as possible in the direction the current is going, and the best authorities say the warp should be kept well aft. If working with a lee tide, considerable care is necessary to prevent the vessel from broaching to so that she will "run the tide," in which event she would be likely to upset the trawl.

"When a vessel has arrived on her fishing ground," according to Holdsworth, "the first part of the tide is chosen for beginning work in, as she can then tow for several hours in the same direction, and the usual practice is to keep the trawl down till the tide is done—about five or six hours."

This is doubtless correct, in a general sense, but in these days of sharp competition there are probably few skippers who will not put out their gear at half tide if they have reached a favorite fishing ground and the conditions are favorable for trawling.

When the ground is reached the vessel's head is laid in the direction in which she is going to tow—this, as has been explained, depending on the direction of the current; but, whether on the port or starboard tack, she lays up by the wind, or nearly so (say within 5 or 6 points), at least until the trawl is shot. After the trawl is out she may be kept off, nearly before the wind, but as a rule, especially with moderate breezes, the vessel's course is laid nearly at right angles to the wind, so that it may exert its fullest force on the sails. If the wind is moderate all sail is kept on the vessel, but if it blows fresh or strong the canvas is reduced so that the smack will go along easily without unnecessary plunging or heeling over.

---

[1] See Plate xv.

"What the trawlers like," writes Holdsworth, "is a fresh, steady breeze—one that would enable them to do 8 or 9 knots off the wind when the trawl is not overboard. They can then afford to lose 6 or 7 knots by the resistance of the net, and yet move fast enough to enable it to do its work properly. Winter is the great trawling time, because then there is pretty sure to be plenty of wind, and, if too much, sail can always be reduced; but unfortunately strong winds are accompanied by a good deal of sea, and when that is the case, although a great deal of extra warp be allowed in order to equalize the strain and prevent jerking, it is difficult to keep the trawl steadily moving over the ground. There is always danger in such cases of breaking the warp, and almost a certainty of doing so and of losing the whole gear if the net should then get foul; and, besides this, the difficulty of heaving up the trawl is greatly increased, two or three hours are often spent in the operation, and the fish are liable to be killed and very much knocked about before they can be got on board. All of these circumstances combine to induce the fishermen to wait for more moderate weather, it may be for only a day or two, or perhaps more, but in any case the supply of fish sent to market is lessened for the time, the weather which puts a stop to the work of one vessel having probably the same effect on most of those fishing in the same district. The Plymouth trawlers are especially subject to loss of time from bad weather in winter, as at that season southwesterly winds prevail at the mouth of the channel, and there is commonly a good deal of sea setting in over their very limited fishing ground, only a few miles from the land. Although they can and do work when it blows very fresh, a succession of heavy gales almost puts a stop to trawling there, and the supply of fish landed at Plymouth fluctuates more than on any other part of the coast."

2. Shooting a Trawl from the Port Side.

If a vessel has just arrived on the ground the bridles are first taken up from the hold—where they are stowed with the towing hawser when not in use[1]—and shackled to the trawl-heads and then coiled down on deck, "the fore bridle forward and the after bridle just before the dandy winch." The end of the towing warp is then taken up, two or three turns are thrown around the "dummy"—the inside or leading part of the warp being on top—and then the bridles are shackled to it, and their coils arranged to run clear. The dandy bridle is next run off the winch, the end passed outside the mizzen rigging, and bent to the towing hawser, just above where the other bridles are shackled on, with a half-clove hitch, the end being stopped back with a small rope. In the mean time (or previously), the cod-end is tied up with the "poke-line," one end of which is taken through the eye-splice in the lower end of the long "cod-line," which reaches to the beam. The trawl is now all ready to be shot, and the beam lies stretched along the port side of the vessel, resting on or against the rail, from the taffrail nearly to the main rigging, with the net piled loosely over it, the forward trawl-head resting on deck and held in place by a stopper, while the after trawl-head, which is outside the stern, is held by two short ropes, called "canting lines," and which serve the several purposes of supporting the after end of the trawl when the dandy bridle has been slackened off, securing and holding firmly in place the trawl-head, and also for "canting" the apparatus when it is being shot.

---

[1] When the vessel is on the ground and engaged every day, or almost every day, in fishing the bridles are rarely, if ever, unshackled from the trawl-heads.

All hands are required to shoot a trawl.

"If on the port tack," writes Olsen, "the captain on the quarter deck gives his orders, looks to see the trawl all clear over the side, attends the after stopper, and squares the gear. The mate and third hand amidships, stream the trawl, and afterwards veer the gear away. The fourth hand stands by to let go the fore head, and the cook takes the helm."[1]

The following are the details of shooting a trawl as observed by the writer:

When all are ready, the lashing is taken off the forward trawl-head, the captain casts off the canting lines and holds them in his hands with a single turn around a cleat or stern timber. The "cod" is now thrown out, followed by the rest of the net, until the whole is clear of the side and trailing out from the beam; which still remains in its place. The time having now arrived, the trawl is lowered, and considerable skill is required to do this properly, for, simple though it may seem, much care must be exercised to insure the landing of the net and beam on the bottom in the right position, namely: With the ground rope below, and the beam upwards resting on the trawl-heads, the mouth of the apparatus being distended. Unless the lowering is skillfully performed the trawl may strike the bottom on its back, which would result in its mouth being closed; therefore no fish could be taken. After the forward head and end of the beam are thrown out, the captain slacks away a little on the canting lines, until the after end of the beam is nearly to the water, but he does not let go of them until the forward end of the beam swings off from the vessel's side at an angle of about forty-five degrees, being slacked away gradually by the fore bridle. When the beam is two or three fathoms astern of the smack, the fore bridle and dandy bridle are usually checked, in order that the skipper may see that the trawl is all right. As soon as the bridles are out the gear is again stopped from running to ascertain if the bridles lead clear, and a good full is given the vessel, so that she may start ahead and straighten the trawl.[2] One man is stationed at the dummy holding one end of a rope nipper, which is around the towing warp (see Fig. 13, page 328), the running of the latter being controlled by this nipper in accordance with the captain's orders. When 20 fathoms or thereabouts of the warp have run out, it is checked, and this is repeated every little while to straighten out the hawser and pull the trawl into shape, until sufficient scope is out; the amount of warp paid away after the gear is on the ground is determined by the skipper, who uses his judgment as to what is required for various conditions of current, weather, depth of water, and the kind of fish that are sought. It is evident that if he allowed the trawl to sink straight down, which would be the case if it was not occasionally stopped, while the vessel moved ahead, to straighten the warp, it would be liable to turn around in the water, in which case it would be somewhat a matter of "luck," whether the net struck the ground on its back or otherwise. It sometimes happens that such a mistake is made, even when the utmost precautions are taken. When this happens the irregular jerking of the warp as the trawl is pulled over the ground shows something is wrong, and, of course, nothing can be done but to get up the gear and shoot it properly.

---

[1] Fisherman's Seamanship, p. 30.

[2] According to Holdsworth the Brixham fishermen do not bend on the dandy bridle to the towing warp before throwing over the trawl, though, so far as I could learn,

If, however, the gear is upset in shooting, it can usually be turned back again, if the trawl has not sunk too far.

"To do this," writes Olsen, "I would lash the helm a-lee, haul down the foresail, take the dandy bridle forward over the bow, heave in on it, and cast the gear back again."

If the trawl seems to be working all right the towing hawser is finally made fast with a "trawl-rope stopper," a 2¾-inch manilla rope, about 5 fathoms long, the bight of which is secured to a stout rope collar on the lower part of the dummy. The ends of this rope are wound around the trawl-warp in opposite directions, over and under, so as to cross and overlap at each turn, which is the ordinary way of putting on a rope stopper, and one end is fastened to the hawser with a piece of small rope, called a "nettle." (See Fig. 13, page 328.) When this is done the rope nipper behind the dummy is cast off, and the turns of the trawl-warp slackened up—sometimes they are taken off the dummy altogether—so that the strain all comes on the stopper. The purpose of the stopper is to save the warp in case the trawl catches on the bottom; for being a

---

this is invariably done by the Hull and Grimsby men. In describing the shooting of a trawl he says: "The lowering is thus managed: The fore bridle is first slacked away until that end of the beam is well clear and stands out at a considerable angle from the vessel, the after part being still kept in place by the dandy bridle, which comes in over the taffrail to the small stern windlass or dandy wink by which it is worked. This rope is then slacked away till the whole beam is in the water, and the inner end of the rope is brought forward to be made fast to the warp, just above the shackle, till it is again wanted, when the beam has to be hoisted up. The beam is now held by the two parts of the main bridle, and they are slowly paid out till it hangs evenly from them; if the whole gear be then in proper position more way is got on the vessel and the warp given out so as to allow the trawl to sink to the bottom, which, as the vessel is under way, it will do at some distance astern."

small rope, and generally one considerably worn, it would, under any sudden strain, break before the hawser, and the trawl would not be lost. When this happens, more warp is paid out, and the vessel is steered in a direction which may, perhaps, clear the obstruction. If this is not accomplished, the next thing to be done is to try and heave up the apparatus. As the warp becomes nearly perpendicular, and the strain increases, the trawl generally comes away clear, frequently with only the net damaged, though the fishermen are not always so fortunate.

In winter a "hawse" is used instead of a trawl-rope stopper. This device is made of a piece of old towing hawser that is not good enough for towing. It is 19 or 20 feet long with an eye-splice at each end, and well parceled to prevent it from chafing on the rail. The inner end is shackled to a chain collar on the dummy and the other is fastened in the usual manner to the towing hawser and reaches just outside the rail. The "hawse" is used to save the towing rope from chafing on the rail. When towing a trawl, with strong winds, the warp is taken off the dummy, and the bight carried forward and stoppered to the forestay with a good piece of rope, and turns are put on the capstan ready for heaving. The bight is also supported along the rail with rope yarn. These precautions are taken to clear any vessel that may be seen to leeward, by coming in stays, which the smack will do at once if the stopper holding the "hawse" is cast off. They are also necessary to prevent the loss of the trawl when the latter comes afoul of rough ground or any object on the bottom, such as a wreck, anchor, etc. The "hawse" will part under a sudden heavy strain, and it can, of course, be cut if it can not be otherwise cleared soon enough; the vessel then swings at once head to the wind.

After being stopped the trawl-rope is parceled where it comes across the rail; it is then pushed into the proper place, where it is held by stout hard-wood pins which are stuck in holes bored in the rail. It may be explained here that on top of the main rail is fastened a false rail, 1½ inches thick, to take the chafe of the towing hawser, and through both of these rails are bored 1½-inch holes, 18 inches apart, near the after end, where the warp usually comes, and 2½ feet apart farther forward. The position of the trawl-warp on the rail depends on how the captain wants to keep the vessel's head. If, for any reason, it is desirable to keep her nearly before the wind the warp is shoved aft to the mizzen rigging, while if she lays off too broad, the hawser is put farther forward and a pin stuck in the rail abaft of it. Sometimes it is necessary to take the warp to the capstan, which is several feet forward of the dummy, but, generally, the vessel will lay near enough the wind without doing this.

When the trawl is out, the tiller is allowed to swing, the sheets are eased off a little, and, as a rule, the towing hawser is placed so that the smack will head a point or two free from the wind. The amount of sail set, when towing the gear, as has been stated, depends on the strength of the wind. The trawlers are all provided with large light sails for use in moderate weather, as well as a large jib and stay foresail, the latter sheeting well aft of the mainmast, and having the special name of "towing foresail."

It will readily be understood that the resistance offered by the trawl materially decreases the speed of the vessel; a smack that is running along from 8 to 9 knots will not tow her trawl faster than 1½ to 2 knots, which is considered fast enough, since if the gear is pulled along too rapidly it will not keep on the bottom.

3. SHOOTING A TRAWL FROM THE STARBOARD SIDE, OR "SHOOTING AROUND THE STERN."

It has already been explained that the trawl, when up, is always carried on the port side, and is also hove up there; therefore it will be obvious that when it is put out from a vessel with her starboard tacks aboard, it must be shot around the stern. To do this (first supposing the bridles are shackled on the trawl-heads, and the cod-end tied up), the after bridle is passed around the stern and coiled down aft, the end being taken forward of the starboard mizzen rigging. The dandy bridle is next taken around the stern under the after bridle,[1] hauled taut and made fast to a cavil amidships, after which it is coiled down ready for running. The bight of the fore bridle is made fast aft of the port mizzen rigging with a slip stopper, and the end taken around outside of all and in forward of the starboard mizzen rigging. The end of the trawl-warp is next taken around (if astern) outside and beneath the bridles, and brought in amidships on the starboard side; enough is pulled over to take turns around the dummy, the bridles are then shackled on, and the end of the dandy bridle made fast. When all is ready, and the vessel going through the water 4 or 5 knots, the captain orders the men to "pay out the net," and at the same time gets the "quarter strap" and canting line all ready to slip, but holds on to them until the forward end of the beam swings clear of the smack's side as previously described. As he slacks away, the dandy bridle, leading from the starboard side, and the fore bridle from the port quarter take the strain and the trawl shoots around or across the stern nearly at right angles with the vessel's keel. When the beam is "square," the dandy bridle and fore bridle are slacked away, and the trawl warp paid out and stoppered in the same way as if the vessel was on the port tack.

---

[1] Sometimes the dandy bridle is used to haul the end of the towing warp under the vessel's bottom. In this case the bight of it is taken around the stern to the starboard side clear of everything, and the end is led forward on the port side and made fast to the trawl-warp, the bight of the bridle being allowed to drop down beneath the keel, so that the warp is pulled directly under the vessel, from the port to the starboard side. Any other piece of rope can, of course, be used for this purpose. As, however, the hawser is liable to chafe when underneath the keel, it is rarely left in that position except in smooth weather. As a rule, the warp is taken around the stern or bow, its bight being stoppered up, if necessary, after the trawl is down, to prevent chafing.

As a rule, when the trawl is out on the starboard tack, a guy is taken from the bow to the towing warp and securely fastened, or may be the bight of the hawser itself is taken up around the bow. This is a necessary precaution at night or in thick or rough weather, since all is then ready to tack ship, either to clear another vessel or to heave up the gear. If necessary, the trawl stopper is cast off, the jib-sheet slackened, the helm put down, and though she may have little way the vessel works quickly, the towing warp pulling at her bow materially assisting her in stays.

After the trawl is down, if it is during the day and reasonably good weather, the fourth hand—usually a lad of sixteen to eighteen years of age—keeps the watch, takes notice how the trawl is working, and looks out for signals from the admiral, if fishing in a fleet.[1] If fishing at night. the watches are kept by the second and third hands. It is a part of the duty of the watch to trim the sails, if necessary, and to note any change in the wind, as well as to observe how the trawl is working. By feeling the warp outside the rail one can easily tell whether the trawl is working right or not. A jerky, irregular motion, as though the trawl was constantly being caught on something, shows that it does not keep steadily on the bottom, or is evidence that it is going over rough ground, or possibly that it has capsized. If, however, the vibration is regular and comparatively slight, the experienced fisherman knows at once that the apparatus is going all right.

According to Mr. Hellyer, the best way to tell whether a trawl is upset or not is to put the ear down to the warp outside of the rail, though, as stated above, an experienced trawler will generally be able to tell whether his gear is fishing or not by putting his hand on the warp.

4. To Change the Tack with the Trawl out.

It often happens, especially when fishing at night, that, owing to a change of tide, or because a vessel may have reached the limit of suitable ground, she is obliged to change her tack, if possible without upsetting her trawl, since in the latter case the gear would have to be hove up or else no fish would be taken. Of course, the gear could be hove up at the start, but this would cause the loss of much valuable time and perhaps two hours or more of good fishing; besides, the crew would be forced to do extra labor, and also have their night's rest broken.

(a). *To wear the Trawl around.*

When the tide is swinging around "by the lee," or when the wind is moderate, it is generally found the safest, in order to prevent the gear from upsetting, *to wear the trawl around.* This is done as follows: If towing on the starboard tack, with an ordinary breeze of wind, the bight of the trawl-warp is stoppered near the stern with a stout piece of rope, the stopper at the dummy is cast off, the bight of the hawser hove over the rail, and the slack of it is pulled in on the port side. In the mean time the foresail is hauled to windward, the helm put hard up, and the after sheets eased off a little. As the vessel falls off—which she quickly does—and is about to jibe, the trawl-warp is stoppered at the dummy on the port side, and the fast on the starboard quarter is cast off. This generally has the effect of causing the smack to swing still more, the wind finally catches the sails on the port side when the vessel comes to at once, so that she heads, as it is intended she should, for towing.

---

[1] Little day fishing is done except in summer, and at that season the majority of the North Sea vessels, at least, fish in fleets.

In wearing from the port to the starboard tack the only difference is that the bight of the trawl-warp must be passed around the stern, and generally, after this is done, a few turns of it are hove over the dummy. Ordinarily a handy smack will wear the trawl round without difficulty, but in light winds it often takes some time to perform the evolution. This maneuver is described as I saw it performed on the *Willie and Ada.* Some fishermen have a slightly different method, I believe. They prefer to take a guy from the lee side around the stern, which they make fast to the bight of the trawl-warp, and putting this on the capstan, heave in on it. Of course they must, in the meantime, get their vessel well off the wind so that the warp leads aft; otherwise it might run under the keel without helping to wear the ship.

(*b*). *To stay the Trawl around.*

For various reasons it is often desirable to *stay the trawl around* instead of wearing with it. This operation is thus described by Olsen:

"First put the helm hard up and run the vessel off before the wind, then pass the warp round the bow to abaft the rigging onto the dummy. Then stopper the bight on the lee bow, let go to windward, put the helm a-lee, and when the foresail is a-back drop the mizzen-peak, let go the bight of the warp on the starboard bow, and when the vessel has paid off before the wind, and brought the warp taut, I would bring her slowly to."

(*c*). *To drop a Vessel around with her Trawl out.*

He would drop the vessel round as follows: "I would bring the vessel slowly to the wind with the foresail down, and when in the wind lash the helm a-lee. As soon as the vessel is steady I pass the bight of the warp round the bow in the same way as in staying, or I would pass a good guy round and heave the trawl-warp upon the starboard bow; then I take the bight of the warp aft on the dummy and secure it, slack away my guy, and set a piece of the foresail aback. In this way the vessel will gradually bring the gear off the weather side, steady her, and secure all.

"N. B.—This system is only used in bad weather when it is needful to bring the ship on the other tack."

(*d*). *To catch the Vessel around with a Weather Tide.*

To perform this evolution he says: "I should let the vessel settle up to windward of the gear by lashing the helm half a-lee, trim the sheets well aft; she will then bring the trawl-warp across the stern, which will ultimately cause the vessel to come round on the other tack. I would then trim the sails immediately and lash the helm a-lee. This can only be done in fine weather."

5. To Prevent a Vessel from Catching Around,

when towing with weather tide and light wind, and the smack is to windward of her gear, Olsen says: "I should bring the guy aft on the lee-quarter, pass it round the stern, and make it fast to the trawl-warp, heave taut with the capstan, slack the trawl-warp, and tow with a guy under the lee."[1]

6. The Working of a Trawl.

The methods of shooting a beam-trawl, and of managing it when out, having been discussed, it seems desirable and proper that something should be said of the action or working of a trawl on the bottom before a description is given of how it is hove up, etc.

From what has been said of the trawl it will be obvious that this implement is designed more especially for the capture of such fish as keep near the bottom and which are generally denominated "ground fish." Among these various species of flat-fish—several of which are the most highly prized of the European sea fishes—are perhaps more easily and surely caught by a beam-trawl than in any other way.

"With rare exceptions all the soles, turbot, and plaice brought to market are caught by the trawl. The various kinds of skate or ray are also obtained by the same means; and notwithstanding the peculiar habits of all these fish there is very little chance of their escaping when once the trawl-beam has passed over their heads."[2]

The movement of the trawl through the water, when it is being towed, keeps the net distended and the back raised some distance from the ground, and as it is traveling with the tide, and the natural tendency of fish is to head the current, it follows that they are liable to be frightened, when their first impulse would doubtless be to attempt an escape by darting in the direction they were heading; this action on their part would take them directly into the cod-end.

"Should the fish, however, by any chance turn around and dart towards the mouth of the net, there would probably be a considerable distance to go before they would be clear, for the ground-rope sweeps the bottom from the foot of the two head-irons to a distance of 40 or 50 feet backwards to the bosom of the net, and this whole space is in-

---

[1] Fisherman's Seamanship, pp. 31–32.

[2] Deep-sea Fishing and Fishing Boats, p. 74.

TRAN. WALKER LIB. UNIVERSITY OF MICHIGAN MUSEUM OF ZOOLOGY

closed above by the back, and at the sides by the wings, so that there is no possible escape in any direction above ground, but at the entrance under the beam. The trawl is moreover moving forwards all the time, and as flat-fish when disturbed only swim a short distance before they again try to hide themselves, it almost amounts to a certainty that, if they do not bury themselves deeply, they will sooner or later pass over the ground-rope into the net. In the case of such round-fish as keep close to the bottom—haddocks, for example—the result is very much the same, for when they are disturbed by the ground-rope they naturally rise and pass the slight obstacle without knowing it; if, on the contrary, they dart towards the mouth of the net, they may escape in that direction; but they also will probably have some distance to go before they can get clear, and the upper part or back of the net is an effectual barrier to their escape upwards."[1]

It is generally found desirable, if there is sufficient wind, to tow a trawl much faster for free-swimming fish than for flat-fish. Thus, while many fishermen think a speed of one-half to 1 knot is ample for catching soles, the Brixham and Plymouth trawlers, when in pursuit of hake, generally tow their trawls from 2½ to 3 knots.

Mr. Sims says: "In fishing hard ground for soles we should shorten the ground-rope and not drag the trawl quite so fast; just go with the tide. But if we are fishing for hake or haddock, then we say 'give her sheet;' that is, force it all you can, so that you do not lift it off the ground."

Of course, this increase of the rate at which the trawl travels over the ground renders the escape of these fish much less probable than it would otherwise be, since the net is kept almost clear of the ground, or barely skimming it, which seems to be necessary to catch hake or other free-swimming species. But, though the trawl scarcely drags on the bottom, it requires a brisk breeze of wind and every sail that can be spread on a vessel to obtain the requisite speed. On the Plymouth and Brixham smacks, according to Holdsworth, "a half square-sail or sort of lower studding-sail is frequently rigged up to a yard-arm on the weather side in addition to the ordinary sails, if the wind be sufficiently aft for it to stand, and the curious appearance is often presented of the vessel lying over to the breeze and apparently rushing through the water when in reality, with all the help of a great spread of canvass and a favorable tide, she is not going more than 5 knots over the ground."

From the foregoing it will be seen that the beam-trawl is a very effective implement for the capture of ground fish on smooth bottom, in comparatively shallow water, where this form of apparatus can only be worked with the best success, as will readily be understood from what has previously been said concerning its construction and the fishing grounds where it is chiefly operated.

---

[1] Deep-sea Fishing and Fishing Boats, p. 76.

7. HEAVING UP THE TRAWL.

Under ordinary circumstances the trawl is hove up when the tide has done running, if it is day-time, or when the limit of a fishing-ground is reached and it is not practicable to tow back over it on the other tack. As a rule, the North Sea fishermen tow all night if the conditions are favorable—tacking or wearing the trawl round with the change of tide—haul in the morning, dress, box, and deliver the fish on board of the carrier,[1] and then, if the day is short, work to windward for another night's drift over the ground. In summer, the trawl is usually shot during the early part of the day, as well as at night, and hove up in the afternoon; thus two hauls are made instead of one. If fleeting, as is the general way in summer, the admiral signals when to shoot and when to heave up the gear. However, it frequently happens that a smack's trawl may catch afoul on the bottom, and therefore it is necessary to heave it up whether it has been out long or not, and it is often found desirable to get the gear at midnight and make a second "shot," especially when fleeting.

The following description of the method adopted on board of the *Willie and Ada* will give a fair idea of how the trawl is hove up and got on board of the ordinary North Sea sailing trawler, in moderate weather:

About 3 o'clock p. m. the fourth hand, a lad of some seventeen years of age, who was on deck, shouted down the companion that he thought the admiral was hauling. The captain instantly ran on deck, bareheaded, and satisfying himself that the report made by the watch was correct, came back into the cabin and called all hands; the men, in obedience to his call, soon making their appearance on deck. When they were all up, the jib sheet was eased off, the helm put down, and two or three of the men shoved forward on the trawl-warp until it was placed on the roller. Two turns of the hawser had previously been put on the capstan, and as the vessel swung slowly head to the wind—helped by the mizzen, which the skipper hauled to windward—the cranks were shipped on the capstan preparatory to heaving, while the cook jumped down into the hold to receive and coil the warp as it came in. When the vessel tacked—which she was assisted in doing by the trawl-warp being so far forward—she "went back over her gear," as it is called, slacking up the hawser, which the men hove in as rapidly as possible until it was tightened again, when the foresail was hauled down, the helm was put a-lee, and the smack brought on the other tack. In this way the skipper continued tacking the vessel, making short boards back and forth, "working up to the gear," while the men at the capstan hove away briskly until all the slack was in. The object of this maneuver was to get in the greater part of the warp with as little labor as possible, since, of course, it is far easier to heave in slack hawser than it would be if there was a strain upon it. Therefore, as the vessel stood back and forth the men at the capstan reported, in answer to the captain's inquiries, if the warp was "coming after her," and, if so, another tack was made. When the slack of the warp was in, the vessel was hove to on the port tack, with the jib sheet eased off and the helm hard down, and the captain proceeded to assist in heaving at the capstan until the bridles were inside the trawl-warp roller.[1] The end of the dandy bridle was then cast off from the trawl-warp by the captain, who took it aft, passed it through the chock on the port side of the taffrail and thence to the dandy winch, upon which it was fixed so that it would wind up without slipping.

---

[1] If the vessel is fishing alone, or "single-boating" as it is called, the fish are dressed and packed in bins or pens in the hold.

The captain generally heaves in most of the dandy bridle alone; sometimes he is assisted by one of the crew, and for the last few feet two or three men may lend him a hand. In the mean time, as soon as the end of the trawl warp comes inside of the capstan, the after bridle is unshackled, its end taken off the capstan, and thrown on deck, or two or three loose turns taken with it around the dummy. This bridle has a piece of spun yarn wound around near its end, which is a mark whereby it can be told from any other rope at night as well as by day.

While two of the men were unshackling and clearing the after bridle one hand cast off the fall of the fish tackle, took it to the forward winch, and hove it taut, so that it might be ready for use when needed.

When this was done and the gear was all clear, the men returned to the capstan and hove away on the fore bridle—the skipper at the same time winding in the dandy bridle—until the beam was alongside, and a strap, which was spliced into the fore bridle a few feet from the trawl-head, was inside the roller. The after end of the beam was then hove snug up to the taffrail and secured. While this was being done two men had hooked the fish tackle into the strap on the fore bridle and began to heave away on the forward winch, lifting the end of the beam and the trawl-head over the rail. As it swung in, the trawl-head was lowered on deck and secured in its place. If there is any sea going, a guy (one end of a rope which is fast to the main shrouds) is rove through the trawl-head by one of the men, who takes a turn with the stopper around the main rigging, to prevent the forward end of the beam from swinging across deck. The next thing is to get in the net. If there is much weight of fish in the trawl, the end of the "cod-line" is taken to the capstan and the cod end is brought nearly alongside. This is done in order to take the strain off the upper part of the net, which therefore can be more easily gathered in by the men. But when the catch is not large and the sea is smooth, this part of the work is generally omitted. All hands then gather the net in by hand, standing a few feet apart and leaning over the beam. (See Plate XVII.) As the vessel rolls to windward a pull is made to get in the slack of the net, which is hauled over the beam and held from slipping back by the men leaning their breasts against it, while they reach out for a new hold. Heavy, hard work this is for five persons to do—two of whom are usually boys—and it frequently happens that the eager looks which are cast over the side to ascertain what success has been met with are unrewarded by the appearance of enough fish in the pockets to indicate a good haul; "and it is a bad sign when nothing is said and the bag is got on board without a word."

---

[1] When there is a strong lee tide it is impracticable to work a vessel up over her gear in the manner above described, and in such cases all that can be done is to heave the smack to on the port tack and get the gear by main strength, and it frequently happens that two or three hours are required to get a trawl up and the fish on deck.

On the occasion concerning which I am writing, though the catch was small, owing to the trawl having been torn on rough ground, the "cod" was not empty by any means. When, therefore, the net had been pulled in so that the cod-end was alongside, a selvagee strap was put around the trawl, the fish tackle hooked into it, and the bag of fish was hoisted up until it would swing in over the rail.

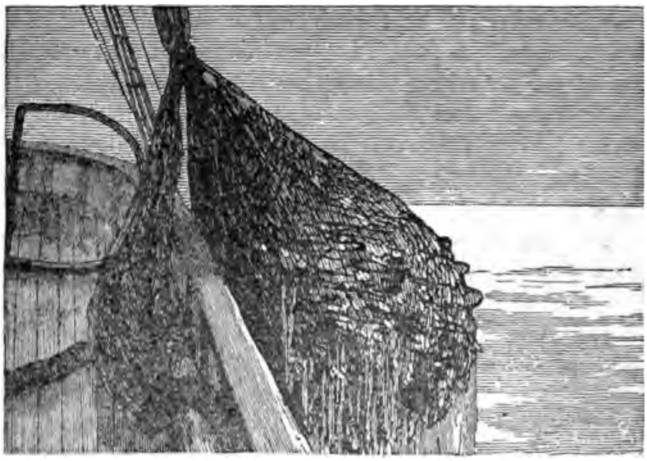


FIG. 20. HOISTING THE COD-END.

While it was being raised, a "bag-rope" was taken from the main rigging to the trawl-head and made fast, to prevent the fish from swinging across deck. When the net was in, the "poke-line" was cast off, the bottom of the trawl opened, and its contents fell on deck, a struggling, writhing, flapping mass. (See Fig. 21.) Nowhere else can one witness such a remarkable scene.

The contents of the net differ according to season and locality, but generally they are of a most varied character—a wonderful exhibition of marine life. Sliding back and forth on the slippery deck, as the vessel rolls in the sea-way, are soles, turbot, brill, and plaice, giving vigorous but rather spasmodic slaps on the plank with their tails; here may be seen the writhing body of a conger eel; there the fierce wolf-fish, with its jaws armed with wicked-looking teeth, snapping at whatever comes in its way, while prominent in the crowd is one of those wide-mouthed fishing frogs, which some one has called an "animated carpet-bag." These, together with gurnards, iridescent with beautiful color, the vicious dog-fish—always the fisherman's enemy—wriggling about, shells, sea-anemones, sea-corn, etc., constituted a variety of animal life such as is rarely brought together by any other means.

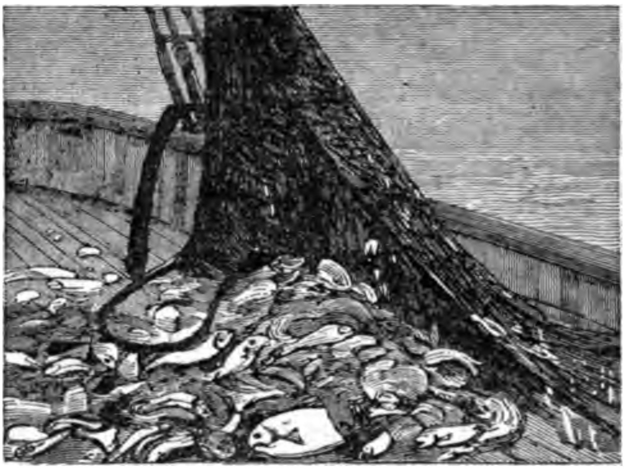


FIG. 21. THE TRAWL'S CONTENTS.

When the net is filled with fish to such an extent that it can not be handled, in the manner above described, a hole is cut in the back, as previously stated, and enough of the catch is bailed out with a dip-net to allow of the trawl being taken in. Occasionally it happens that large stones are caught in the trawl and, getting into the "cod," hang down with such great weight that it is difficult, if not impossible, to raise the net in the ordinary way. At such times a long rope slip-strap, or a "clench," made with a running bowline, is put loosely around the trawl and sunk with the deep-sea lead, which is tied to the bight of the strap. When it is low enough it is hauled taut, taken to the capstan and hove up alongside.

The heaving up of a trawl on the single-masted cutters is about the same as that which has been described, the principal difference being that the warp is taken forward and comes in over the bow, the vessel lying head to the wind, the light sails and stay foresail being taken in before the work begins.

Mr. R. L. Ashcroft, of Southport (near Liverpool), England, writing under date of November 14, 1884, gives the following description of the methods of handling a beam-trawl on the west coast of England:

"I was out trawling from Fleetwood a fortnight since, with one of the large boats. I should like you to see how easily their gear is worked in comparison with the east coast boats. Our smacks here fish a 56-foot beam of greenheart, and the boat is only 56-foot keel measurement. But we turn out when we haul the net and haul by the bow, and when we have got the bridle on the winch we take the 'dandy' or span bridle, or, as they call it here, the head rope, which is now made of steel wire rope, to a wink or Spanish windlass aft, between the cabin companion and the bulwarks, and get the after end of the net up. Afterwards, we winch the forward bridle up and let the after rope bridle surge until we have the forward trawl-head almost up, and then hook the fish-tackle into a becket on the forward bridle, and take the fall to the winch barrel and coil it on until the iron of the trawl is clear of the rail. Then one of the crew gets hold of the winch barrel under his arm, and, the pawls being lifted up, he watches the roll of the boat and lets the iron come inboard by letting the winch at liberty.

"In the boat I was in there are only four men in the crew, and they made all the nets required."

The time requisite for heaving up a trawl varies a great deal, depending chiefly on the state of the weather, roughness of the sea, depth of water, direction and strength of the tide, as well as upon whether the capstan is worked by hand or by steam. Captains who have used steam say that, under favorable conditions, they have got a trawl up—heaving in 120 fathoms of warp—in the short space of fifteen to twenty minutes, while some claim that from twenty to twenty-five minutes is sufficient to heave in the whole warp, even in rough weather.

Heaving a trawl up by hand is not only hard work, but the process is tedious to a degree, rarely occupying less than forty-five to fifty minutes, and sometimes, when the weather is rough and the vessel knocking about, taking between two and three hours.

It will be obvious that when steam trawlers are employed the conditions are quite different from those which obtain on board of a sailing vessel, since a steamer can go in any direction which it may be necessary for her to proceed, and consequently many of the various evolutions which have been described would not be performed. The shooting and hauling of the trawl is done in much the same way, except perhaps that some, if not all, steamers use a derrick for hoisting one end of the trawl and a davit for the other, and that there may be some difference in the minor details of the method of working. It will be readily understood that, owing to the fact that a steamer is always able to tow in any desired direction, so as to take the utmost advantage of tide and the "lay" of the ground, as well as to go at the requisite speed in calms as well as at any other time, vessels of this class are much more effective for working a beam-trawl than those which depend solely on sails.

The following account of a trial trip of the new steamer *Caller-Ou*, of Granton, Scotland, clipped from the Scotsman of December 18, 1883, may be of interest in this connection: "One of these exceptional days in December, when there is a clear sky overhead, a sharp breeze off the land just sufficient to give a fair trial to a vessel under canvas, and when there has just been restored comparative calm to a sea which had been angry during the storms of a whole week before the *Caller-Ou* sailed down the Firth from Granton with a considerable number of gentlemen on board interested in trawling and deep-sea fishing. It was not until the vessel was off Craigleith, 18 or 19 miles down the Firth, that the trawl was put out. The depth of water was from 14 to 15 fathoms. Of course, the experiments were conducted more with a desire to test the working of the trawl and its appointments than to secure a large haul of fish; and therefore the trawl was kept out during an hour only. When at work under ordinary circumstances, these steamers trawl during, on an average, four hours. Ponderous as the trawl is—the heavy beam, the great net, and the massive iron hoop-like structures which at each end of the beam keep the mouth of the bag or net open as it sweeps along the bottom of the sea—the working of it by the machinery available was a matter of comparative simplicity and ease. Once cast into the sea, the trawl is dragged along at a speed of between 2 and 3 miles an hour, being attached to the ship by a great wire rope, which on Saturday was run out to a length of 75 fathoms. The most interesting part of the trial was when, after the lapse of an hour, the trawl was drawn on board. Here, again, the steam machinery appeared to work satisfactorily, and in the course of a few minutes the beam and the iron structures were lifted over the side of the ship. The net or bag was still in the sea, and as the crew hauled it on deck its contents were watched with much interest. Soon it was thrown on the deck, containing a couple of hundred weights of white fish—whiting chiefly, with three or four cod and codlings, a couple of skate, a few haddocks, some ray, a few flounders, a young turbot, and two crabs. This catch, it is obvious, was not a large one for a great trawl such as that described. But the brief period during which it was at work, and the fact that the ground covered was not considered good, or the ordinary fishing-ground, were said to account for the catch being so small. The fish, however, were taken up in splendid condition—full of life and in as cleanly a state as might be desired. Whether the short period during which the trawl was at work accounted for it, or whether it was that the condition of the sea-bottom was exceptionably favorable, the trawl was laid on the deck wonderfully clean—clear of mud, or of any perceptibly objectionable matter; and it was stated that this is the condition in which the trawls are usually taken on board in ordinary weather in the Firth of Forth. Attention was also directed to the quality—the intermixture of immature with mature fish. There were, it was admitted, very few immature fish. There was one codling only 10 inches long, but the other specimens were excellent. There were, probably, half a dozen very small whitings, one small skate, and one small, but not apparently immature, flounder. On the whole, however, the apparently immature fish were, in number, hardly worth speaking of—not more, it was asserted, than would have been got among an equal total catch by net or line. If possibly disappointing as regards the quantity landed, the result of Saturday's trial was all that was anticipated in other respects; the fish were brought up in excellent condition, and the proportion of small fish to the whole catch was almost incredibly small. There were also in the net several varieties of the smaller conditions of life at the sea-bottom, many being well-developed forms, and others very minute. On this point one of the party pointed a comparison between the contents of the trawl net and that of a surface net which was worked from the deck of the vessel over three-quarters of a mile of sea. The contents of the surface net, it was stated, included a greater number and a greater variety of life—very minute forms, of course—than did the contents of the other; showing, as it was believed, that life was more abundant on the surface than at the sea bottom. But, one observer also remarked, the sea bottom here was not so rich in the smaller conditions of life, which form food of codlings and such fish, as is the ground over which trawlers usually work or on which the larger catches are taken. Such, briefly put, is the result of a trial trip the results of which, to those most closely concerned, were regarded with satistaction. It may be added that the owners of the *Caller-Ou* contemplate the building of other vessels like her for the Granton deep-sea fishing should a reasonable experience of the working of this one prove remunerative."

8. SINGLE BOATING AND FLEETING.

Two distinct methods of trawling are carried on by the British vessels, called "single boating" and "fleeting."

The single-boating system is the oldest, having been pursued since the advent of trawling. By this system each vessel goes to sea and fishes presumably by herself, or, at least, usually has no connection with any other craft, the master pursuing his work in whatever waters he deems most suitable. Ice is carried for the purpose of keeping the fish, when going to a considerable distance from the home port, the catch being packed below in bins or pens built in the hold of the vessel, until she arrives in port, which may be anywhere from one to twenty days. The Brixham trawlers, in summer, frequently land their catch twice a day, when the conditions are favorable, in which case no ice is required, but the North Sea single boaters are generally out from one to three weeks. According to the report to the Board of Trade, "some of these vessels go out a very long way in order to find the fish, quite as far if not farther than is the practice with the fleets, and it often happens that many of them are found to be congregated together on the same fishing ground, sometimes as many as from fifty to one hundred at one time. The 'admiral' of Hewitt's fleet stated it to be his opinion that if all the smacks in the North Sea went single boating it would lead to a crowding of vessels at times which would be more dangerous than fleeting."[1]

Of course, where the fishing grounds are near the home port, and the fish can easily be taken to market in an absolutely fresh condition, as at Brixham, for instance, the single-boating system prevails, and wherever this is pursued each skipper is thrown upon his own resources in choosing his ground, shooting and hauling his trawl, as well as in the care of the fish and getting them to market. Where, however, as in the North Sea, the best fishing grounds lie at great distances, comparatively speaking, from the market ports, and, consequently, the vessels must be out several days, it sometimes happens that the fish are in poor condition before they arrive. This, therefore, is a serious objection to this system, which, notwithstanding, is preferred by many fishermen to fleeting, the latter being considered much more dangerous, especially in winter. The trawling fleets from many, if not most, of the large ports pursue the system of single boating in winter, and more or less of the vessels from all other places do likewise.

A portion of the fleets, however, from Hull and Yarmouth follow the "fleeting" or "boxing" system even in winter, and nearly all of the trawlers along the east coast of England adopt this method during the summer. Under this system arrangements are made for a number of vessels to trawl in company, thus forming a "fleet" the movements of which are governed by an "admiral," who is appointed *pro tempore* and who is known to be an expert and experienced fisherman. He decides where fishing shall be carried on, when the trawls shall be shot and hauled, and the movements of the other smacks are controlled by signals which the admiral makes. All the vessels in a fleet generally shoot and haul their trawls at the same time, and sail together on the same tack, in obedience to the signals made by the admiral, who, it may be mentioned, usually receives some extra pay for his services.[2]

Flags are used for signaling by day, and rockets or flares at night.

"Each fleet has its own particular code," writes Mr. Ansell, "one of which is the following:

Admiral's signals by day.

For sailing	Flag at foremast head.
For trawling	Flag hauled down.
Not to board	Flag at mizzenmast head.
Sailing before boarding	Flag both mast-heads.
Cutter wanted	Flag half-mast.

---

[1] Report to the Board of Trade on the system of deep-sea trawl fishing in the North Sea, London, 1883.

[2] Mr. Samuel Plimsoll, chairman of the South London Market Company, in an article published in the London Fish Trades Gazette of June 2, 1883, states that the admiral receives, in addition to his pay as skipper, 3*d*. for each boat every time her fish are taken out by the steam carrier.

Admiral's signals by night.

For sailing	White rocket at intervals.
For tacking	Flare on quarter and a white rocket.
For trawling on port tack	Three flares and a red rocket.
For trawling on starboard tack	Three flares and a green rocket.
For hauling (getting the trawl)	Two flares and two white rockets at one time.
For laying to	One flare at mast-head and one on the quarter with a white rocket.

In strong winds the fleet sometimes get scattered, and to facilitate their gathering again without loss of time, different places of rendezvous are arranged according to the season of the year, thus:

From February 1 to March 1	Tail end of the Dogger.
From March 1 to August 1	Off the Horn Reef Light-boat.
From August 1 to October 1	Clay Deeps.
From October 1 to February 1	The Silver Pits.

These are well-known places to all fishermen."

Messrs. Hewett & Co., of London, are reputed to have been the first to establish the fleeting system, which they did by arranging to have the large number of smacks they owned combined into one or more fleets, that, as now, were controlled by an admiral, while each day's catch was shipped on board of a swift-sailing cutter which took the fish to market, several of these cutters being in attendance on a fleet so that no time was lost. In all weathers these "carriers" could be seen hovering about the North Sea fleets, and nowhere in the history of seafaring life can there probably be found any better examples of courage and hardihood than were exhibited by the crews of these cutters. Winter or summer, so long as they could show any canvas, they were driven through all weathers almost to the verge of destruction. The object was to bring the fish to market fresh, and so long as this was accomplished little was thought of hardships, perils, and discomforts, which it is difficult for one to imagine who has not had the experience of continually forcing a passage at sea in a small and deeply-laden vessel.

Even at the present time, at least as late at 1880, essentially the same system was carried on from Hull and Grimsby; a limited number—anywhere from ten to thirty—vessels would combine interests and form a fleet, which frequently would be all the property of one firm. These vessels would, as a rule, all share alike, and the smacks took turns in carrying the catch to port, the admiral's flag being transferred to some other craft when his "turn" came to go to market. A fleet of this kind is called a "cutter fleet"[1] in distinction from the "steamer fleets," which are much larger—numbering from seventy-five to one hundred vessels or more—and are attended by several ketch-rigged screw steamers, called steam cutters, which carry out a supply of empty boxes for the fleet, to take the place of those filled with fish, also provisions and letters for the fishermen. But their chief work is to carry the fish from the fleet to the port where they are to be landed, generally London, Grimsby, or Hull.

---

[1] Sometimes the crew of the cutter which receives and carries the fish to market pack the cargo in bulk, putting ice among the fish, as on the single-boaters, rather than to use boxes. A fleet, therefore, which sends its catch to market by one of its own sailing vessels is often called a "bulking fleet," because of this system of packing fish in bulk.

"One of these cutters is generally arriving every day at the fleet, and the fish which has been caught by the smacks, and has on board of them been packed in boxes, is transferred or 'boarded' in the smacks' boats to the steam cutter, with which she then goes back to her port of discharge.

"Single boats also are in the habit of transferring their fish to these cutters if they chance to fall in with them, and if the cutter has room, which is usually the case, the steam cutters charging so much per box for carriage.

"The smacks engaged in 'fleeting' remains at sea for periods varying from six to eight to ten weeks, when they return to their port to refit. From Yarmouth there are about six hundred and seventy smacks engaged in 'fleeting,' and from two hundred to two hundred and fifty in 'single boating' in the winter, and in the summer nearly all are engaged in 'fleeting,' and from Grimsby there are about three hundred engaged in 'fleeting' and one hundred in single boating in summer, but none of them go fleeting in winter."[1]

The same necessity exists now for getting the fish to market as soon as possible which led to the hard driving of the sailing carriers, and probably no vessels in the world are forced harder in all weathers than the steam carriers which now attend upon the North Sea fleets, and which rarely fail to make their passages from the most distant fishing grounds to Hull, Grimsby, or London, in from thirty-six to forty-eight hours.

A writer in Land and Water, who made a cruise in a North Sea trawler in December, and returned to port on a steam carrier, gives the following account of the passage, which will convey a good idea of the conditions under which these vessels frequently make their trips to or from the fishing grounds: "It is impossible to convey even a general idea of the journey back without entering into an amount of nautical detail, for which I have not time. The present age is certainly remarkable for earnestness and zeal in most official men; but there was in the dear, good, clever, brave, old man who brought that vessel home an intensity of devotion which it was positively refreshing to observe. He carried sail when the sea washed all over the ship, and every now and then came down in deluges into the stoke-hole, all but extinguishing the furnaces. As to the little cabin, in which we were supposed to live, it was literally drowned, hardly a dry thing being left in it, and the little stove being almost instantly extinguished every time it was lighted.

---

[1] Report to the Board of Trade on the system of deep-sea trawl fishing, etc.

At one time I thought to go in for the luxury of dry boots, so I put a pair before the fire; but in a few moments after a sea struck us, and when I looked down the companion again I saw one boot jammed upright at the foot of the ladder full of water, and the other gaily careering all over the floor upon the bosom of a festive wave, which had floated up all the small gear and so-called furniture, and was then engaged splashing the table underneath. All this time the good skipper never wearied for a moment, and never left the deck except for a few seconds to snatch a mouthful of food, or a drink of cold, creamless tea, which was his only beverage; but forced the vessel through the heavy sea with steam and sail combined until he carried away the gaff, and then with steam alone, until he brought us safely, in what even he owned to being 'coarse weather,' through some of the most dangerous and intricate channels on the coast, and finally reaped the reward of all this great labor and anxiety when he heard from his employers that his cargo was in time for market, and that they were pleased with his exertions."

In regard to the system of fishing pursued by the Grimsby trawlers, Mr. Mudd writes as follows under date of April 29, 1882: "Our vessels fish in fleets principally in summer, and one or two fleets continue all winter. A fleet of about one hundred and fifty smacks are attended upon by four or five steam carriers of 130 to 150 tons register, fifty to sixty horse-power engines, which carry their fish to market in ice; so that the smacks carry no ice; they [the smacks] go on the grounds for eight or ten weeks' fishing, then come home for a week and off again. This is the most profitable system of fishing.

"Steam trawling is a great rage just now. I helped to form a company last year. We have two boats which have been at work three months with fair success. We are going in for four more."

Steam trawlers, as a rule, go on the single-boating system, generally carrying on their operations within 20 to 60 miles from the land, from which distance they can easily reach the markets while their catch is in good condition. Sometimes they act in the capacity of carriers and trawlers, too, fishing in a fleet, the product of which as well as their own catch, they take to market. It may be explained in this connection that it sometimes happens that sailing trawlers can do little fishing for several days at a time, because of a continuance of calm weather. On such occasions the steam trawler finds her opportunity, and by the time that the fleet gets a good day's fishing she may have obtained a large catch herself, which adds materially to the income she may derive from the carriage of fish.

"When single boating," writes Dunell, "they often average £60 per week in their gross catch. During the summer they act as carriers to a large fleet of sailing smacks. After being out about a week they will catch £40 to £60 worth of fish themselves, and at the same time bring in a cargo in boxes from the sailing smacks. This arrangement is found lucrative to the company and a great advantage to the sailing vessels, as it insures the fish being delivered in good condition and obviates the necessity of the smacks making long voyages to and from their port, often with contrary winds. The advantage of this system to that of having steam carriers proper, is, that in the calm weather, frequent in summer time, the smacks can not work their trawls, so that the carriers having no fish to take must lie idle, their resources unemployed, and their ice running to waste. On the other hand, the steam trawler is enabled to work without wind, and may catch fish which will be, perhaps, additionally valuable on account of the enforced idleness of the other vessels."

Higher prices can generally be obtained for fish which are taken to market by the steam carriers than for those brought in by the single boaters, though this is not an invariable rule.

It may occasionally happen, according to the report to the Board of Trade, that smacks fleeting are obliged to keep the fish on board for several days on account of the rough weather preventing their being conveyed to the steam cutter, and as the fleeting vessels do not carry ice like the single boats, it is quite possible, under such circumstances, that the fish may arrive in inferior condition. One witness stated that he had known salesmen to fill the steam-cutters' boxes with fish out of a single boating smack in order to enhance the price.

The fleeting system is preferred by the owners, though the fishermen are in favor of single boating. It is claimed that the fleeting system is more profitable, that it is a necessity for the owners that the returns should be not only quick and large, but subject to as little fluctuation as possible. Whilst, however, "a difference of 20 per cent. in the returns may make a difference to the owner of a fair profit or a decided loss, it only makes to the man sailing on shares a reduction of, say, from £2 to £1 12*s.* per week, and to the man on wages it makes no difference at all." Therefore, it is not, perhaps, to be wondered at that the fishermen prefer the system of single boating, and that several objections are urged by them against fleeting. Chief among these objections are the hard and perilous work of "boarding" the fish, and the much longer time that they are obliged to be absent from home.

The Duke of Edinburgh, in his excellent paper on the Sea Fisheries, etc., gives a graphic picture of the dangers incident to boarding fish as carried on under the fleeting system, which he concludes by saying:

"No one will deny the great importance to the owners of smacks of getting their fish to market in a salable condition, but they are bound to effect this object without exposing the fishermen to dangers, such as I have above indicated, but against which no means of prevention have, as yet, been devised or adopted. I have alluded to this subject here as an illustration of the risks of a fisherman's life, and can not leave it without expressing my opinion in favor of a careful and searching inquiry being made on each occasion on which a fishing vessel returns to port having lost any of her crew whilst at sea. This inquiry, it seems to me, should be conducted by a competent authority, whose duty it would be to satisfy himself and place on record the manner in which the life was lost, whether by one of these preventable causes or not. For, at present the fact of a life being lost at sea is the only record which exists, no matter how it occurred."

"To sum up the advantages or otherwise of these two systems," says the report of the Hull investigation, "we are of opinion that the 'single-boating' system, whilst insuring to the men less hardship and possibly conducing to instruct them in a more perfect knowledge of their business as fishermen, is also productive of a great waste of fish. The fleeting system, on the contrary, is calculated to secure a more regular and continuous supply in a fresher state. We are not inclined to attach much importance to the argument that in 'single boating' there is less danger from the congregating together of a number of vessels. We have it in evidence that a great number of 'single-boating' vessels are found together, and we are of opinion that the fact of their then sailing each at his own will without the regularity insured by acting in concert, as in a fleet, is of itself an increased danger. A single boat getting mixed up with a fleet would have a similar effect. The danger of collision to these vessels has been shown by numerous witnesses to occur chiefly in fine weather and in the daytime, not owing to circumstances connected with 'fleeting' *per se*, but to a habit amongst the skippers of visiting one another in such weather when trawling can not be carried on for want of wind, and leaving their smacks in charge of the boys. The same results may ensue when two or more single boats meet together under similar circumstances."

9. CARE OF FISH, "BOARDING" FISH, ETC.

The various kinds of fish taken in trawls are classified under two general heads of "prime" and "offal," while all other material, such as invertebrates, radiates, etc., receives the name of "scruff" or "sculsh." "Prime" fish are the choicest varieties, which bring the highest price in market, such, for instance, as the sole, turbot, brill, and dory, while cheaper and less desirable species, such as haddock, gurnards, plaice, flounders, skate, etc., are called "offal."

"Red mullet must be excepted, however," says Holdsworth, "for, although not strictly coming under the head of 'prime,' they are what the Billingsgate salesmen look upon as 'West End' fish."

The fish are dressed, sorted, and packed away as soon as is practicable after the trawl is taken up. As has been stated, the fish fall on deck from the cod-end in a slimy, struggling mass, and, if there be any sea, they go scurrying and sliding from side to side as the vessel rolls back and forth. The fishermen use ordinary clasp-knives, or what are usually termed "jack-knives," of a large size, for dressing the catch, each man being provided with one of these, that he carries in his pocket when not using it, and which he employs for various other purposes for which a knife may be required, such as filling his pipe, cutting rope, etc. Dressing fish, so far as we have had an opportunity of observing it, is carried on in a primitive way, differing very much from the elaborate methods employed by American fishermen. The men either stand in a stooping position, picking the fish up from the deck, or else sit down and grab whatever comes first to their hands as the fish are carried back and forth when the vessel rolls. The fish are simply eviscerated, such as are dressed, for it often happens that, when "boxing," certain species are not even gutted. If it be a round fish (that is, a cod, haddock, etc.), a slit is made in the belly, the viscera pulled out, and the "poke" cut off where it joins the gills. If a flat fish, it is cut across on the upper or dark side of the abdominal cavity, and the intestines are pulled out with the right hand, the operator holding the fish by its head in his left hand. The fish are packed in the boxes with the white or belly side up, and the slit does not show, while any blood or water that may be in it will escape. As the fish are dressed they are sometimes, though not always, roughly sorted into the grades of prime and offal, but more attention is paid to the culling after the whole have been washed. Up to this point there is little difference in the methods employed on board of either the single-boaters or vessels that are fleeting, except it may be on trawlers like those from Brixham, the catch of which is rarely dressed at all, but taken in and landed in small baskets.

If the vessel is single-boating the fish are, as previously mentioned, stowed in bulk in pens or "pounds" made in the hold by shifting or adjustable bulkheads. The prime fish are generally kept separate.

If, however, the vessel is fleeting, the fish are disposed of in a very different manner. As soon as they are dressed and washed, a number of empty boxes or "trunks" are taken on deck (each smack always has a supply of these), and the fish are carefully packed in them, according to grade, after which a string is tied across the top opening, to prevent the contents from falling out while being transshipped. Each box is labeled with a wooden tag, on which is the name of the vessel and that of the salesman on shore to whom it is consigned, while a note or duplicate bill of lading, showing the number of boxes of each kind of fish going from the smack, is made out to send with the shipment. The fish are now ready to be taken on board of the carrier, near which the whole fleet of smacks has gathered in the mean time, numbering, if it be a "steamer" fleet, anywhere from seventy-five to one hundred and fifty vessels. The operation of "boarding" or "ferrying" the fish from the catcher to a steam carrier has been so graphically described by a correspondent of "Land and Water," that I can do no better than to quote it here:

"The boat is then launched over the side, no matter how heavy the sea may be,[1] and the necessary number of men, generally three, jump in, and their mates on board hand them down the boxes, which when full weigh about one hundred-weight each. Sometimes there are very few boxes to go, or in certain cases none at all; at other times there may be as many as fifteen or twenty, or, in the event of the smack having been unable to send any for a day or two previously, there may occasionally be more, but this is not very usual. The boat is then towed behind the smack with a painter of about 10 fathoms in length, and the smack makes sail either ahead or astern of the steamer, or sometimes round and round until she has got it into such a position that they are likely to be able to reach by themselves, when she lets go and they make their own way with oars. The whole of this proceeding is little short of wonderful; in fact, it is impossible for any one to understand what these men can do with their boats without seeing it. A common, awkward-looking row-boat is first pushed over the gunwale into a heavy sea, and almost before the fact of its having got safely in without being swamped is realized, a man has somehow swarmed over the side and got on board, a turn of the painter is taken round a belaying-pin on deck, two other men follow the first, and the crew hand in the fish, the sea all the time rising and falling to a height of 18 feet or 15 feet, and not one of those engaged appearing to take the slightest notice of it or in any way betraying the smallest consciousness that there is a sea at all. Then the towing with a long rope, which I have never seen before, is most remarkable, and the effect of a number of vessels running down together towards the carrier, each every now and again on the crest of one wave while its boat is on the crest of the next and the long painter is taut in the mid-air between, is something quite beyond one's ordinary experience, and forms a rather interesting study. The quietness, too, with which they knock about among each other in a heavy sea is somewhat instructive, no special lookout or symptom of anxiety being anywhere apparent, and yet all giving each other clear berths and no collisions happening. Verily, great is the confidence inspired by real knowledge and constant practice. And now the boats approach the carrying vessel, the men in them sing out, 'Let go!' those on board reply, 'All gone!' and then the rowing begins, and up and down they go on seas so heavy that every now and then they are lost to sight for an uncomfortable length of time. At last they approach the vessel, and though to an unaccustomed eye it might be supposed that they must be swamped in coming alongside, they come on all the same, not even keeping a lookout, so far as one can observe, but running in every direction full tilt onto the ship, and as each boat touches, a man watches his chance, and just when the boat rises takes hold of the rail and swarms up over it and fairly tumbles on the deck, holding one end of the long painter in some way, either in his hands, under an arm, or sometimes in his teeth.

---

[1] "This work," writes the Duke of Edinburgh, "is carried on in almost all states of weather, such is the importance attached to the immediate dispatch of the fish that the men never seem to think of the possibility of danger to themselves. I have heard of a trawler's boat, with its cargo and crew, being actually lifted by a sea to the deck of a carrier and there left.

"In the excitement and struggles of a large number of these tiny boats, each of which is striving for the first place, or in the subsequent endeavors to reach their own vessels, accidents are necessarily of frequent occurrence, too often attended by loss of life."

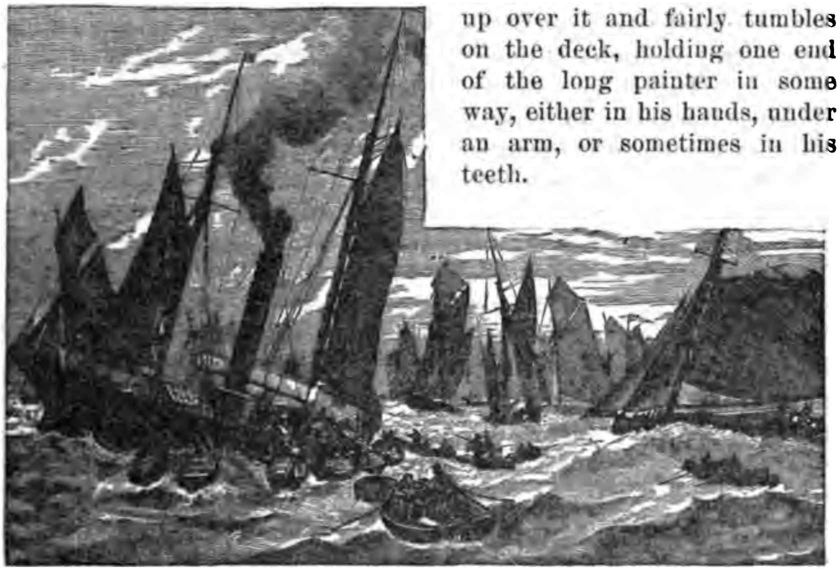


FIG. 22. BOARDING FISH.

"He picks himself up at once, rushes on to the shrouds or to a belaying-pin, takes a turn, and sings out, 'All fast!' and then one of his mates in the boat, who has been paying out, hauls short on the painter until he gets abreast of the waist of the ship or some other part that may be vacant; the men in the boat immediately hand up the boxes one by one, their own man receives them over the rail and tosses them on deck, then puts his delivery note into a basket in the galley, and his work is done. It is the business of each smack to deliver her own cargo on the deck, and no help is given for the purpose, not even in the small matter of making fast a painter or helping in a trunk, and the short time occupied in the operation, as well as the apparent certainty and safety of the whole proceeding, are, to say the least, surprising. Indeed it seems little short of miraculous that in a sea with a rise and fall of quite 10 feet some eighty or ninety open boats should be launched overboard, manned and loaded, towed and rowed a considerable distance, brought alongside a vessel, unloaded, brought back, and hoisted on board again without a single accident, yet I saw this done without anything approaching to a misadventure, and from the general bearing of all concerned I could observe that there was no anxiety whatever on the subject."

Notwithstanding no accident occurred on the occasion referred to above, and although the fishermen exhibited no anxiety, it is nevertheless a fact that the ferrying of fish is accompanied with a great deal of risk and peril, and it not unfrequently happens that men are drowned while engaged in this service. Concerning this the following report was made to the Board of Trade: "During the progress of the investigations held before us it was repeatedly shown that this operation of 'boarding' the fish is conducted without regard to order or system of any kind whatever. So soon as the steam cutter arrives at the fleet, each smack hastens to send its boat alongside first, to fetch stores, letters, etc., and empty boxes for future use, and again to load the full ones on board the steam cutter. The smacks sail up close to the steam cutter, some on one tack and some on the other, dropping their boats alongside as they pass ahead of her, where they lay to, waiting to pick up their boat again. Many boats by this means get congregated alongside the steam cutter at the same time, and a struggle ensues as to who shall unload his fish first. The result is that boats are frequently smashed and sometimes capsized, occasionally entailing loss of life to the hands in them. Some of the smacks also are in the habit of running so close to these boats that a wash is produced, which increases the danger. In the Hull and Grimsby fleets the men who man the boats discharge the boxes onto the deck of the steamer and then generally lower them into the hold, where the steamer's crew stow them away, assisted by a certain number of smack hands, who are paid a gratuity for this work. In Hewett's fleet it is the rule for the boxes to be placed only on the deck of the steamer by the boat's crew."

It may be mentioned here that attempts have been made to devise some other means for transferring the fish from the catcher to the carrier. A sketch was exhibited in the British section at the International Fisheries Exhibition at London, showing how the transfer could be made by means of an endless rope working between a smack and a carrier, the fish boxes being tied to the rope, and pulled on board the steamer through the water. Laboring under the mistaken idea that the beam-trawl fishery is carried on in American waters, Mr. John Bland, of London, who, it would appear, is the deviser of this scheme, addressed a letter to the President of the United States, in which, after speaking of the danger attending the "boarding" of fish, he takes occasion to say: "I would suggest that at a distance of 60 or 100 yards the collecting steamer throw by rocket a slight line to the smack. By means of this line the smack would draw to itself an endless rope, to be arranged over a loose block 6 or 8 feet above the deck. A box or barrel of fish would be attached to the lower part of the rope by means of a simple hook, then dropped overboard, and drawn to the steamer by steam-power. A few minutes immersion would not do the slightest harm to the boxes, and as the water would support the greater part of the weight, a dozen packages of fish might be attached to the rope at the same time, with a short distance between them, say one box for every 6 yards of rope. By this means I believe the catch could be transferred, day or night, and in almost all weather, with a tenth part of the present labor, and no risk to life or boats, as quickly as the steamer could haul the boxes up her sides. A supply of empty cases could be sent to the smack in the same manner."

Whether this plan will be found feasible or not it is difficult to say. We could not learn that any practical test of it has been made. But the difficulty of keeping two vessels at the proper distance to work in a heavy sea without danger of collision would unquestionably be found very great, and then only one could work at a time, which would be of small consequence when a hundred others were waiting to discharge their fish.

In a remarkably brief space of time the steamer's deck is filled with boxes, which as fast as possible are being transferred from the deck to the hold, this transfer being actively conducted by the carrier's crew, who are sometimes assisted by the men from the fishing smacks. Each steamer has a compartment in which enough ice is carried to preserve the fish. This place is called the "ice-house," and is connected with the main hold—where the fish are stowed—by a hole in the bulkhead which can be opened and closed as required. While part of the steamer's crew are busied in passing down and stowing the "trunks" of fish others are hard at work converting the blocks of ice into fine particles, and when a tier of boxes have been stowed in the hold a layer of fine ice is thrown on them, and so the work goes on until the hold is filled (if there be fish enough) with alternate layers of fish and ice, a few baskets of the latter being thrown on top of the last tier of boxes. Over all is laid a cloth, and then the hatches are closed and securely battened down.

In the mean time the confusion, incident to getting the fish on board and the chaffing of the smackmen who crowd the steamer's deck, has ceased; most if not all of the boats have returned to their respective vessels, which may now be seen stretching off together in obedience to the admiral's "sailing signal," while the carrier's bow is pointed for port, and no time is lost in getting all sail set that she will carry, for no effort is spared to increase the speed.[1]

H. MARKETING THE CATCH; FISH CARRIAGE, ETC.

1. *Landing the fish at Billingsgate.*—The arrival of a steam carrier in the Thames is immediately telegraphed to London from the signal stations near the river's mouth, and Billingsgate makes all necessary provision for receiving and disposing of her cargo. As soon as she arrives her load is rapidly transferred from the steamer's hold to the

---

[1] It does not always happen that enough fish are taken to make a sufficiently full cargo for a carrier to go to market with, in which case she may wait until another day to complete her load.

market by a gang of men, who take the trunks of fish on their shoulders and heads, and passing in single file back and forth over gang-planks that stretch across the decks of barges, or pontoons, form one of the most peculiar and grotesque processions one ever has the opportunity to see. By some dock regulation, or because of a lack of sufficient depth of water, the steam carriers are prohibited from coming alongside of the pier, upon which the market building stands, to discharge their cargoes. Large pontoons are moved in front of the market, and to these the vessels make fast, so that the fish must be carried a distance of 75 to 100 feet or more. Gangways of plank are laid from the steamer to the pier, but as these are often unprotected by railings of any kind, it sometimes happens that one of the fish porters falls into the river, a mishap which is liable to have fatal consequences. But since it is the business of those bringing fish to Billingsgate to "make their own roads," less attention is paid to safety than would seem desirable. Nothwithstanding an occasional accident the work goes on vigorously until the whole cargo is landed, and the carrier is once more ready to proceed to sea in quest of the "fleet" she attends, and to brave again the perils and discomforts of a passage to and from the North Sea fishing grounds.

2. *Selling fish by auction.*—The great gong striking the hour of 5 in the morning announces that the salesmen of the market are to begin business, and with a hurry-scurrying rush they reach their desks, surrounding which are a number of low benches or tables, upon which are placed the fish that are put up at auction, sold, and speedily cleared away to give place for new stock, this process being repeated over and over again until the sale closes. As fast as the fish arrive in Billingsgate, after the day's sales begin, they are rapidly disposed of at auction,[1] the salesmen using their long account books, instead of a hammer, to knock down the goods. One can not imagine a more novel sight than can be witnessed here in the early morning when business is at its full swing, the porters rushing hither and thither with packages of fish on their heads, quite regardless of whom they may jostle or be-

---

[1] "The auction," says a writer in "The Fisheries of the World" [published by Cassell & Co., London, 1883], "was formerly conducted in Dutch fashion, so called; the prices sinking till they reached the level of some one of the purchasers, who was not allowed to inspect, except in the most cursory manner, the bargain he was trying to secure. Nowadays most salesmen are licensed auctioneers, and the goods are quickly knocked down to the purchasers in the usual manner. Soles, plaice, fresh haddocks, skate, etc., are sold in 'trunks,' but cod and ling by the score or half-score. Herrings are sold on the vessels alongside by the long hundred, a very long hundred, for it exceeds that number by thirty. Eels are also sold for the most part on the Dutch boats which bring them, and sprats are sold on board the vessels by the bushel. Salmon, salmon trout, and some of the finer fish are sold by private contract."

The average wholesale prices, as stated by a leading salesman of Billingsgate to Mr. R. W. Duff, M. P., are as follows: Sole, salmon, brill, gray mullet, John Dory, whiting, and eels 1*s.* (equal to 24 cents) per pound; haddock, sprats, cod, herring, coal fish, plaice, ling, and hake bring an average of only 2*d.* (4 cents) per pound.

daub, for no one stands on ceremony, and politeness can not be observed in the midst of a pushing, surging crowd, every individual of which seems to think only of the business that he is intent upon.

"The only comparison," says Sala "I can find for the aspect, the sights and sounds of the place is—a rush. A rush hither and thither at helter-skelter speed, apparently blindly, apparently without motive, but really with a business-like and engrossing preoccupation for fish and all things-fishy. Baskets borne on the shoulders of the *facchini* of the place skim through the air with such rapidity that you might take them to be flying-fish. Out of the way! Here is an animated salmon leap. Stand on one side! a shoal of fresh herring will swallow you up else."

On all sides may be heard above the general din the stentorian tones of the loud-voiced salesmen, who perched on their stands, and raised somewhat above the heads of the hurrying crowd around, shout their calls to attract buyers. From one we hear the cry: "Here, ye sole buyers, sole buyers, sole buyers, who'll have this fine trunk of soles?" While a rival calls out: "This way, ye haddock buyers, come on haddock buyers, give us an offer for this lot of fine haddocks." Others call for "cod buyers," "plaice buyers," etc., through the whole list, perhaps, of edible fishes, until the confusion of sounds is so great that a stranger can scarcely comprehend how business can be conducted under such circumstances, and it would be impossible for one who has not seen it to form any conception of such a scene as may be witnessed on any week-day morning at Billingsgate. One thing is more remarkable, perhaps, than anything else, namely, the method of bidding, which seems peculiar to the place, for though we tried hard to catch the sound of a buyer's voice, or to detect a sign by which he indicated his bid, we ingloriously failed in every instance, which was rather mortifying when we were made aware that the sharp-eyed or keen-eared salesmen had received dozens of offers from persons in the crowd almost at our elbow.

As fast as the fish are sold they are removed by porters and the vacant places filled by new material until the sales end for the day. While fish are sold at auction in Billingsgate, the system of selling by Dutch auction generally prevails in the markets of the smaller ports where there are no licensed auctioneers.

"On the coast the fish is generally bought by a buyer who is in direct communication with some firm at Billingsgate, which acts as the buyer's salesman. At Billingsgate the fish is either bought by the retailer direct, or by a middleman, who is known in the market as a 'bomaree.' The 'bomaree' fulfills the same functions in the fish market which the 'regrater' used to discharge in the corn market. He buys fish for which there is no immediate demand at the moment, and sells it again later on in the day. * * * But for his intervention many small retail tradesmen would be forced to attend the market at an hour when their attendance would be inconvenient to them. The 'bomaree' enables the small costermonger to postpone his visit to Billingsgate till he has disposed of his purchases of the previous day."[1]

Such are some of the features connected with the selling of fish at Billingsgate. Elsewhere mention is made of the methods of receiving, selling, and shipping of fish at Grimsby, which differ somewhat from those in vogue at London.

3. *Fish sale at Brixham.*—In the summer of 1883, while making a brief visit to Brixham, the writer had an opportunity of learning something of the methods of trawling, as pursued from that port. Since the description of the care of fish, marketing, etc., which we have given applies more particularly to the methods adopted by the North Sea fishermen, and at the larger ports, it may be of interest to say something here of how the business is conducted at Brixham. The vessels employed from Brixham are mostly single-masted cutters which fish not far from its harbor, though a number of ketch-rigged trawlers which go to the North Sea are owned there, and for about two months in summer a few Brixham boats fish off Tenby, in Wales. With the exception of those fishing in the North Sea, each of these vessels carry a crew of three men and a boy. The vessels fishing about home stay in harbor on Sunday, as a rule. They generally land their catch every day—usually in the morning—sometimes twice a day when the conditions are favorable. They carry no ice. As soon as the trawl is got on board in the morning the vessel is headed for Brixham, and all necessary sail is set. The fish are assorted and packed in small baskets called "pads," of which there are two sizes, one holding about 10 or 12 pounds, and the other double that quantity.

If the weather is fine the cutter heaves to outside the pier, the boat is got out, the fish put into her, and two of the crew take the "lot" to the harbor, where they land their cargo at the market. As soon as the fish are sold—sometimes before—the men return to their vessel that, in the mean time, has been jogging outside, and which immediately heads off for the fishing ground again. If the wind blows fresh this can not be done; therefore the smack anchors outside, if the wind is off the land; otherwise she goes to Dartmouth, Torquay, or Plymouth.[2]

The baskets have the vessel's mark attached to them, so that they may be known. All fish are sold at auction to the highest bidder, and not at "Dutch" auction, as at Grimsby, where the *first* bidder takes whatever is being sold. The sales at Brixham begin at 9 o'clock a. m., and continue as long as fish arrive at the market.

---

[1] The British Fish Trade, by Sir Spencer Walpole, lieutenant-governor of the Isle of Man, pp. 58, 59.

[2] In a paragraph entitled "Sea Fishing on the Southwest Coast," by J. C. Wilcocks, which appeared in the London Field of February 28, 1885, the following statement was made relative to the Brixham smacks going to other ports: "The largest number of trawlers delivering fish at Plymouth during the past week was a hundred. Between thirty or forty of the vessels were from Brixham, the whole of the smacks belonging to Plymouth being a little under seventy in number. The increase in number of vessels delivering fish at Plymouth was owing to a strong east wind. At Brixham the largest number of vessels delivering fish was only thirty-five, a small number for this important fishing port."

They are conducted by a number of salesmen, who dispose of the fish as fast as it arrives, 15*d.* in the pound being charged for commission on sales, and dock fees. The prime fish goes chiefly to London, offal mostly to country trade, the greater part of the conger eels finding a market at Manchester. A number of women were at work cleaning and packing the poorer grades of fish, chiefly small haddocks, which are hawked about the interior towns, while a somewhat better grade was being packed in carts and wagons with ice; these, it was said, were for sale at Torquay.

4. *Shields as a fish market.*—Shields has of late grown into considerable importance as a market for trawled fish, since it now has a large fleet of steam trawlers.

The following account of the arrival of a fleet of steamers at the Shields fish market, and the sale and shipment of their cargoes, is quoted from the (London) Fish Trades Gazette of October 17, 1885:

"When mild September gives place to chill October, and the last of the herring boats has spread its brown wings and disappeared, north or south, as the case may be, then the steam trawler seems to settle itself down to business, to proudly take sole possession once more of the fish quay at Shields, just like some party who had been bewildered and harassed by summer visitors and was right glad to get rid of them. There is a wealth of all that is picturesque in the herring fleet, its toilers, and their doings; but the steam trawler, in full winter vigor, gives you a picture that is thrilling—one that serves to make you totally oblivious to the keenest blast from the North Sea when you have screwed up the courage to steal from beneath the blankets and venture down to the low lights in the early morning. A befitting companion picture is to be had in the scene on the quay after the fish is landed, and salesmen are bawling themselves hoarse, when big consignments are being hurried away and fishwives are in full tongue. Being anxious to look on the scene as a whole, from beginning to end, the writer the other morning found himself shortly after 6 endeavoring to secure shelter from a biting sea breeze, under the lee of a pile of casks and boxes, beneath a huge shed, which serves as dispatching department to the various dealers. There was little astir that indicated the scene of life and bustle which was soon to follow. Everybody seemed to be bent on shelter like myself, and the spacious boarding of the quay was tenanted only by awkward lorries lying here and there. Eventually, there was a movement of one or two individuals, who looked as if something to do would come as a relief, towards the extreme end of the jetty, which reaches out into the river and gives a view down the harbor and out to sea. There they stood, hands thrust elbow-deep into their pockets, and, sucking vigorously at local twist tobacco, gazed out onto the waters. 'What's the matter with those fellows?'

I asked of a neighbor. 'They're only looking if anything's coming,' was the reply. Presently, signs of animation amongst the group drew others along, myself amongst the number. The first trawler was in the offing. However, there was some dispute on the point. 'I tell yee it's not the ——,' says one. 'It's the tug ——,' says another, and so on, until one ancient looking individual, who pits his eyesight against the younger of the crowd, exclaims, 'It is the ——. There's her derrick. And there's her beam.' The object of dispute seemed some miles away. I watched her for some half hour, growing larger and larger, now sinking to all appearances in the water up to the top of her funnel, then riding in bold relief on the top of a wave. Several others had been sighted in the meanwhile, and all were voted trawlers. The first one seemed bent on getting first to the river, and again and again huge rolls of black smoke came from her funnel, mingling with occasional puffs of steam which rose from her valves as she lifted to the seas, these demonstrations of activity bringing forth the remark, 'He's firing up, anyhow.' At length she came between the piers and into the smooth water of the river, and with her paddles slowly dabbing the water, drew alongside the quay. It was low water, and from the quay above an over-all view could be had of her decks. Her black funnel was powdered like a wedding cake several feet upwards, where the spray had struck it and left the white salt hard baked on. The last shot had evidently been a good one, for the sorting of it up had not been completed. Several of the hands encased in oilskins, and looking like yellow lobsters standing on end, were busy putting the cargo to rights. The fore-deck was divided into pens, like a cattle market, each kind of fish being stuck amongst its own kith and kin. During the whole of the operation the quick pulsations of the donkey-pump were heard, and one of the hands vigorously plied the hose-pipe right and left as a kind of polishing up of fish, deck, boxes, and boards. A pile of baskets were then put aboard, and filled, so much into each, as far as the smaller fish would go. These, with the larger fish, brought up in twos and threes, were then hauled on to the quay, and taken charge of by assistants of the salesman who usually had the 'selling' of the boat. Whilst all this was going on, other trawlers had arrived, one after the other, and assembled round the quay, until there was a general hauling up of fish going on, to the accompaniment of donkey-pumps working, lorries rolling to and fro, and shouts from the men ashore and afloat.

"The scene on the quay was now one of great animation. The fish had been taken along from the trawlers and placed in various lots upon the quay. The larger fish were sorted up into groups; for instance, you might see two or three cod, or two or three ling, lying together, and here and there a conger, a grim-looking cat-fish, halibut, turbot, or monster skate. The plaice, soles, codlings, whitings, etc., remained in baskets. It was a sight to see this mustering of the tribes of the deep all still in death, save generally the refractory conger, who always did refuse to adapt himself to fish-market circumstances; and the plaice, with their beautiful orange spots. With the latter the auctioneer's hand, of course, had no trouble, for they, jammed head first into baskets, could only feebly flip their tails. But as to the conger, he invariably shows that 'there is life in the old dog' by wriggling astray from his proper squad, and joining the stock in trade of some other dealer. A knock on the head generally brings him to his senses—or, rather, knocks them out of him—for awhile; but he invariably tries another move when the fit is over, and so on until, like a sensible fish, he agrees that 'it ain't no use going agin the grain.' The cargoes of the trawlers are almost invariably eked out by a basket or two of crabs, crawfish, and a whole category of nondescripts, which give an interesting insight into marine life of the lower depths of the ocean. Soon some five or six auctioneers were busily engaged in selling the fish, and the running-fire of chaff appeared to be endless. The sales, on an average morning, last over some hours, and on turning attention from the group which are standing round the collections of fish on the floor we find that the trawlers have, for the most part, either gone, or are in the act of casting off from the quay, to go up river to secure coals for the next trip. The close of the auction sales does not, by any means diminish the animation on the quay. For a long while afterwards buyers were busy moving their purchases to their respective packing sheds, where a number of busy hands were always to be found. About the most queer sight of the fish quay was that of operations at the 'gutting' tubs. The corporation have provided a proper place for the fishwives—who hawk fish locally—to gut and cleanse their purchases before setting forth on their rounds. Here some half dozen quaintly-dressed women were up to their wrists in the animating operation of emptying haddock, cat-fish, and the like, their tongues keeping up a round of merry gossip.

"Before the trawlers were seen going to sea again, the bustle of the day was about over. I watched several of the boats depart, and could not help thinking that their calling was as risky as it was hard. They have to bear up against downright bad weather before giving in, for when the sea is rough and trawlers are few, then high prizes are made. The boats often suffered by sudden outbursts of bad weather; and sometimes, thinking that it might blow over, have had to plow their way home through a perfect hurricane. As if to preface them for this kind of ordeal, they invariably get a dusting during October. Despite their daring, however, accidents are few, and happily it is several years since any of them got into serious trouble. Somehow they always seem to be unlucky in the spring, for when the approach of Easter sends up the price of fish, the weather is generally so rough as to defy them leaving home."

5. *Fish carriage.*—The subject of fish carriage is one of great impor-

tance so far as the success of the British beam-trawl fishery is concerned, but for obvious reasons its various features will not be discussed at length in these notes. As has been shown, large quantities of fish are taken direct from the fishing fleets in the North Sea to London; the amount of fish thus carried from sea to Billingsgate has been estimated by competent authority at 42,000 tons yearly, while 90,000 tons reach London by land.[1]

"Owing to the fact," writes Mr. Plimsoll, "that Grimsby and Hull are so much nearer the fishing ground than London is, by far the larger portion is carried into those ports and thence off by night trains to London.

"The more valuable kinds of fish on being landed are packed into large boxes or hampers, but the 'kit' haddocks are put loose into what are called machines. These machines are long boxes lined with lead, some 15 feet long by 5 feet broad and 2 feet deep, which are divided internally into four equal spaces, each of which holds half a ton of fish, and the machine is carried on the railway on a truck or wagon with low sides. On arriving in London these machines are lifted bodily from the railway wagon by a powerful hydraulic crane, lowered onto a strong street trolly, and drawn by horses into Thames street, where they form a line sometimes a quarter of a mile long, and these are the things (and these only, as any one may see any day by going into Thames street that cause the obstruction and overcrowding, as containing the less valuable fish, they wait until the vans containing the prime, which is sold first, are unloaded. The detention is sometimes for eight or nine hours (the average over a long period was found to be four hours and forty-nine minutes), so that the average detention of the tanks containing offal is probably not under six hours. Some cod and other kinds of prime are carried in these tanks or machines, but the quantity is very small indeed, compared with that of the 'kit' haddock—the great bulk of cod, etc., being packed in boxes and hampers."[2]

Much fault has been found with the rates charged for the transportation of fish by rail, it being claimed by interested parties that these are excessive. As, however, this is somewhat of a local matter, it does not seem necessary that anything more than a passing allusion should be made to it.

It is proper, however, to remark that the carriage of fish, notwithstanding complaints that have been made concerning delay, seems to have reached a high state of perfection, and it would, no doubt, be to the advantage of the American fish trade if swift-running trains could be employed in the United States, as in Great Britain, for transporting fish. According to the Duke of Edinburgh, only about 400 tons of fish were condemned at Billingsgate in the year 1881 as unfit for food, a large proportion of which was shell-fish. This, he thinks, speaks well for the system of carriage, as London receives a yearly supply of about 143,000 tons of fish.

---

[1] "It must not be supposed," says Walpole, "that the whole of the fish brought to London are consumed in the metropolis. On the contrary, London is the central source of the supply of a district which every year tends to become larger. One of the most certain consequences of improved locomotion is the concentration of trade. It is found practically more convenient for buyers and sellers to meet in one place than to scatter themselves among a great many places. In nothing is this tendency more perceptible than in the fish trade. London and Birmingham, and to a lesser extent Manchester and Liverpool, are the markets from which nearly the whole of England is supplied with fish; and London is annually becoming to a greater extent the center of supply."

[2] Fish Trades Gazette, June 2, 1883.

I. METHOD OF DIVIDING THE PROFITS.

There are certain local differences for the division of the money obtained from sales of fish caught by trawling smacks, but the following table showing the apportionment of a trawling smack's assumed earnings of £800, furnished by Mr. Sims, of Hull, and published in the report of the inquiry at Hull, by the Board of Trade, will give a clear idea of the methods adopted for settlement at the large trawling ports on the North Sea:

Assuming that a smack earns £800 to "settle on," that is, available for division between owners and crew:

	£	s.	d.
The skipper's share is	137	10	0
The second hand's share is	112	10	0
Provisions found by owner for the three other hands, say	60	00	0
Wages for three other hands, say, £1 15s., and 10s. per week	117	0	0
Insurance, on £900, the assumed value of the vessel, at 3 per cent	27	0	0
Repairs for wear and tear of vessel, sails, spars, fishing-gear, cleaning bottom, etc	250	0	0
Interest on £900 at 5 per cent	45	0	0
Depreciation of vessel	50	0	0
	799	0	0

	£	s.	d.
The skipper's share	137	10	0
Less provisions	20	0	0
	117	10	0

or £2 5s. per week.

	£	s.	d.
Second hand's share	112	10	0
Less provisions	20	0	0
	92	10	0

or £1 15s. 4d. per week.

The foregoing statement suggests the approximate earnings of a first-class North Sea trawler and her crew. As a matter of course there is considerable variation in the amount earned by different vessels, some stocking more than £800 and others much less; the average gross earnings of sailing trawlers, according to Dunell, for the three years ending in 1883 was £650 per annum.

The earnings of steam trawlers are much greater, as a rule. The steam trawlers belonging to the Grimsby company for the year ending February, 1883, averaged £2,500 to each vessel, but as these carry more men and their expenses are necessarily much larger, the crew's share is not so large in proportion as the difference in the relative stocks would seem to indicate.

In conversation with the skipper of a Brixham smack, I was told that 400 pounds of fish (exclusive of rays) is considered a good day's catch for one of the trawlers working off that port, and this amount is rather above than below the average. If a vessel stocks £4 a day it is thought she is doing well, and a skipper's share does not generally exceed £1 per week, and if he make 5*s.* or 10*s.* more than that he is thought to be "lucky."

According to Mr. Charles Hellyer, of Hull, the maximum earnings of a sailing trawler from that port, clear of stock charges, are £1,400 a year, while he thinks the fleet average £850.

He thinks an average year's work for a skipper not owning any of the vessel would be £146. The skipper takes eleven sixty-fourths of net stock, mate nine sixty-fourths, and third hand, if by share, gets occasionally nine sixty-fourths, but generally eight sixty-fourths, or is paid by the week, the wages being about £1 per week and found by owner. The deck or fourth hand is generally hired, as there are few apprentices now, and gets 18*s.* per week, while the cook's wages—he being the smallest—ranges from 10*s.* to 12*s.* per week; both of these are "found" by the owner. In addition to the shares and wages the crew have exclusive right to the fish livers, the proceeds from which are divided into four shares, the skipper, mate, and third hand getting a share each, the deck hand two-thirds and the cook one-third of a share.

According to the Duke of Edinburgh:

"The crews of the trawlers engaged in the North Sea are fed by the owners, and receive a certain rate of pay weekly, in addition to which they are paid a percentage of the amount realized by the sale of all fish caught."

This statement, that the crews of the North Sea trawlers are fed by the owners, is only partially correct, as has been shown, since the sharesmen pay a part of the "grub bill." And it is also a fact that a portion of the crew are hired, at least from some of the larger ports, and have no pecuniary interest in the catch. The statement he has made may apply to certain localities, as Yarmouth, for instance, but it is not generally applicable.

"The system of division on the Channel trawlers is somewhat different, namely:

	Shares.
Owner receives	3¾
Master receives	1¼
Two men, each 1 share	2
Total	7

The boys do not share in the catch.

Mr. Jex tells me that the crews of all the Yarmouth trawlers are hired by the week, receiving, however, a certain part of the stock resulting from the sale of the fish. The weekly wages paid at the present time to the skipper and crew amounts in the total to £3 12*s*., equal to about $17.50. Besides this, three-twentieths of the net stock is divided among the crew, the skipper taking nearly half—1*s*. 5*d*.—while the rest is divided among the other men. This is called "poundage," because it is a certain part of each pound earned by the vessel. It should be stated that when the drifters (herring vessels) are at work the wages frequently are much larger than quoted above, for the reason that the men are sought after by the skippers of the herring catchers. At such time it is often necessary for the owners of trawlers to pay as much as £5 (about $25) per week for the skipper and crew, to keep the men.

The Yarmouth men are "found" in gear and provisions, the owner paying all expenses.

The skippers and men are shipped as they can be obtained, as in New England. The men often make a demand for increased pay, and, if the vessel is ready for sea and men scarce, they frequently succeed in obliging the owners to pay high wages.

J. EFFECT OF BEAM-TRAWLING ON THE ABUNDANCE OF FISH ON GROUNDS FREQUENTED BY BRITISH VESSELS.

Much has been said and written, *pro* and *con*, concerning the effect of beam-trawling upon the abundance of fish. Among practical fishermen there appears to be a remarkable consensus of opinion on this subject. With few exceptions they believe that there has been a very marked diminution of fish on all the grounds ordinarily visited by beam-trawlers, and not a few are ready to predict almost the entire destruction of many species, while instances are cited of fishing grounds that were formerly rich fields for trawling, now being so poor that they are seldom visited. It is a somewhat remarkable fact that the first notice obtainable of the use of trawls, the petition to Parliament in 1376–'77, quoted on page four of this report, speaks of the destruction of immature fish and the consequent evil effect on the fisheries liable to result from the use of such apparatus. The same thing has been repeatedly brought to the notice of the British Government, and a great mass of evidence has been submitted to establish this point, and urged as a reason for putting restrictions upon beam-trawl fishing. The annual report of the London Fish Trade Association for 1883 calls attention to the report of the fish-supply committee, dated August and November, 1881, and which, among other matter, contains the following:

"The first point which struck us, and upon which undoubted stress should be laid, is the destruction of spawn and small fish, and the taking of immature fish. The evidence proves conclusively that large quantities of immature fish are uselessly destroyed, and also that many of the ancient fishing grounds have been and are greatly deteriorated and have ceased to be productive, and we are of opinion that the court should communicate with Her Majesty's Government, urging that legislative steps be promptly taken to remedy these evils."

On the other hand several eminent scientists have claimed that it is quite impossible for man to materially influence the supply of fish life in the ocean. And it is a singular fact that almost at the very time (winter of 1883-'84) when the Scotch fishermen (chiefly those engaged in line fishing) were testifying before a royal commission, and stating with scarcely a dissenting voice, that the system of beam-trawl fishing was ruining the inshore grounds to such an extent as to make them almost worthless, fish of all kinds should be found off the Scottish coast in numbers not equaled for many years. Mr. T. F. Robertson-Carr, writing under date of February 12, 1884, says:

"Both trawler and line fishermen have had heavy catches of cod, ling, haddock, and flat fish; both as to size and quality all are agreed that this season's fish are rarely surpassed."

The following clipping from the Edinburgh "Scotsman" of February 21, 1884, is corroborative of Mr. Carr's statement. Under the heading of "Remarkable Success of the Winter's Fishing on the Scottish Coasts," it says:

"At the last meeting of the Scottish Fishery Board returns from the various districts were presented, showing that unprecedented success had attended the prosecution of the winter fisheries on certain parts of the Scottish coasts. In the Eyemouth district no less than 92 tons of haddocks were caught in one week, the value of which was £1,300. The average earnings reached nearly £45 per boat, and during the season the total quantity of haddocks landed by 30 boats was computed at 924 tons, realizing to the fishermen something like £12,666. This, it is estimated, would give an average yield and value per boat probably exceeding that for the corresponding period of any previous year. The Montrose fishermen met with similar success—the haddock fishing in that district having been rarely, if ever, so remunerative. In one week some of the crews realized from £36 to £45 per boat.[1] The enormous hauls obtained for some time have not, however, been confined to haddocks. In the Anstruther district there were 12,365 crans of herrings landed in one week, during which 3,400 telegrams were dispatched and 800 fish wagons loaded. At Wick, in one week there were landed, in addition to an estimated catch of 941 crans of herrings, immense quantities of whitefish, comprising about 16,443 cod and ling, 690 saithe, 10¾ tons of plaice, 2½ tons of haddocks, 2½ tons of halibut, 3½ cwt. of brill, 4½ cwt. of soles, 760 skate, etc."

Though the above would seem to throw considerable doubt upon the correctness of statements which go to show the decrease in the abundance of fish on trawling grounds, we nevertheless can not lose sight of the fact that the testimony of those best qualified to know positively the merits of this question can scarcely be thrown aside as of no value. The following extracts from a lecture delivered by Mr. Edward Jex, C. C. (a salesman at Billingsgate, formerly a practical fisherman, and still a smack owner), at the Norwich Fisheries Exhibition, in 1881, will be of interest in this connection as showing the other side of the question:

---

[1] The crews alluded to here number seven persons to each boat.

"I am well aware there are those who will not admit of any falling off in the supply of trawl fish, but the old proverb, that facts are stubborn things, is strictly applicable to this case; and I do not doubt that, by adducing the plain incontrovertible facts without any distortion, I shall be able to prove that the answer just given by me is the perfectly correct one. For this purpose it will be necessary for me to go back for a few years from the present—twenty to twenty-five will suffice. At that period a first-class trawling vessel was not more than half the size of many of the splendid vessels of to-day, some of them from 50 to 80 tons, and working a beam nearly if not fully double the length; consequently the mouth of one of these nets will go over double as much ground as a net would twenty-five years back, and with what result? One of the small vessels, with a net about half the size, would at that period take, in nearly every case, as much fish in one night as one of these large vessels now obtains in a week, and the fish were much larger; in fact, the full-grown matured fish were so plentiful that the small fish, such as taken now, would at that time have been valueless. The gentlemen present who have been engaged in the trawl-fishing for so long a period will, I have no doubt, be able to corroborate my statements. I also wish to impress upon you, my hearers, that there are now fully five or six times the number of vessels employed in the deep-sea fisheries around our coasts than there were twenty-five years ago; yet with all this increase in vessels, and the increased size of the net, we at the present time find, and have found for some time past, a very large falling off in this branch of the fisheries.

"Thirty-five years back there were from the port of Hull 25 vessels engaged in trawling, their combined tonnage was 625 tons, and their insurance value £6,000, but to-day there are 450 vessels, their tonnage 31,500 tons, and insurance value £450,000.

"The surest index to the supply of fish is and always will be the quantity which is upon sale in the various markets, and the prices of the same. Twenty years ago soles were sold 12*s.* to 20*s.* a trunk, plaice and haddocks at 5*s.* per pad, and all other kinds of trawl fish at equally low prices and within reach of the humblest families of the land. But as time has gone on so has the trawl fishing gone on, I am sorry to say, for the worse. That splendid and nutritious fish, the sole, is being swept out of our seas, is no more the cheap food of the poor and middle classes, but is nearly a luxury on the rich man's table, and is almost a rarity to some fishmongers' shops. During this last month I have sold trunks of soles at from £5 to £10, and plaice at from 15*s.* to 21*s.* per trunk, haddocks from 12*s.* to 16*s.*, and all other kinds of fish have been proportionately high.

"To what cause can we assign these high prices? Simply that the shortness of the supply of fish is out of all proportion to what it was for vessels twenty or twenty-five years back. If it were not so, we should find it bear strongly in favor of the purchaser, but with the large numbers of vessels of the finest class, and every means man can use for the capture of fish, we have found the decrease in the catches has had such an effect on the advance in prices that the smack owner of to-day, in many cases, is quite unable to live by his industry; his vessel and gear, instead of being a source of profit, are a burden upon his means. For the past few years I fear there are but few who have cleared their way, particularly trawlers. Not only in the price is the difference to be noticed, but in the size at the period of which I am speaking; twenty-five years ago the fish sent to the various markets of the kingdom were of a proper size, but such is not now the case. At the present time a very large proportion of the fish sent for sale to the various markets are but little more than small brood and fry, and ought not to be captured. This is not only the case of one particular description, but is applicable to every description of fish taken with either the trawl, drift, or seine, and other nets I have before named. Take, for instance, the small plaice and haddocks from several parts; likewise let us look at the small immature fish sent for sale from all parts of the coast. The sole, which has acquired the designation among the buyers of 'slips' and 'tongues,' these tongues vary from 5 to 9 inches in length (and it must be borne in mind that I am speaking of the appearance of such fish in our markets not as infrequent but as of daily occurrence), there are of these small immature fish as many in one box as would fill four to six boxes, at least, if they were allowed to grow twelve months longer. These small fish frequently fill only half or two-thirds of a box, and are covered over with a few middle and large-sized fish. No person will for a moment contend that such small immature fish are fitted for the food of mankind. Why is it that these small fry are caught and the food of our increasing population destroyed?

"I will here mention some of the principal fishing grounds, and I can say most emphatically that many of them are depopulated to such an extent that very few will pay a trawler to work them; others are becoming in a like state as rapidly as possible. There is not one of the fishing grounds I will here name have the fish upon them there were a few years back—Rye Bay, the Diamond Ridge and Varne, the Falls, Inner and Outer Gabbard, the Flats, Smith's Knoll, the Lemon, Shoals of the Hurry, Winterton Ridge, North Northeast Hole, Well Bank, Black Bank, Surat Bank, Botany Gut, Silver Pits, Southwest Pit, Northwest Pit, Clay Deep, Southwest Flat, West Shoal, Dogger, Swash, Dogger Bank, East Rough, Inner Ground and Off Ground, Outer and

Inner Rough, on the coast of Jutland, Horn Reef, Borkum, Ameland, Texel Hakks, also the Little and Great Fisher Bank, and the grounds off Penzance, Plymouth, Brixham, and Dartmouth."

Mr. Jex, like many others, believes the cause of this depletion, is due, in a great measure, to the smallness of the mesh in the cod-end of the trawls. This fact is so well recognized by many trawl fishermen that, as has been mentioned in a previous chapter, various devices have been brought forth to insure the escape of immature fish.

Just what will be the final result of beam-trawling on the supply of fish it is now difficult to say; time alone can tell. While, however, it may be conceded that many who are in good positions to judge accurately have grave apprehensions of the future, it goes without saying that the fisherman who depends on his work to support himself and family can not afford to look beyond the present, but must use his utmost endeavors to catch all the fish he can, since it is for that purpose he ventures forth to brave the perils which always surround him.

K. A CRUISE ON A BRITISH NORTH SEA TRAWLER.

Previous to my departure from the United States to attend, on the staff of Prof. G. Brown Goode, the International Fishery Exhibition held at Berlin, Germany, in 1880, I was instructed by Prof. Spencer F. Baird, United States Commissioner of Fish and Fisheries, to make one or more cruises on a first-class beam-trawler, if it was found practicable to do so. The object in view was that a practical study of the beam-trawl fishery might be made, and as much information gathered of its details as would enable me to prepare a report sufficiently full and explicit to convey to American fishermen a comprehensive idea of the apparatus used and the methods of fishing. Professor Baird, being fully cognizant of the importance of the beam-trawl fisheries of Europe, and having in mind the enormous extent of the fishing grounds to which citizens of the United States have access, deemed it desirable that this should be done. The result of my studies of the British beam-trawl fishery, then and subsequently, has been given in the preceding pages, to which the following account of a cruise in a Grimsby trawler may, perhaps, be appropriately added.

Leaving Berlin on the evening of June 20, 1880, with Professor Goode and his private secretary, Mr. Julius E. Rockwell, we reached Flushing the following evening, and arrived in London on the 22d. On the next day after our arrival, Professor Goode and myself met Mr. Spencer Walpole, now lieutenant-governor of the Isle of Man, but then nspector of British salmon fis heries, who very kindly gave us the benefit of his knowledge and advice in regard to the best locality to visit in order to gain definite information of the beam-trawl fishery. This he decided to be Grimsby, at the mouth of the Humber River, and which is one of the most important fishing stations in Great Britain. He also provided me with a letter of introduction to Mr. Harrison Mudd, a gentleman largely interested in the fisheries of Grimsby, and who held the official position of a town counselor of that port.

Passage for New York had been, provisionally, taken for our party on the North German Lloyds steamship *Neckar*, which was booked to sail from Southampton July 6, and it was thought that if I could get away on a trawler within a day or two there would be ample time to make a short cruise—long enough to get an idea of the fishery—and for me to reach Southampton soon enough to join the rest of our party on the *Neckar*, though this was only a secondary consideration, which was not to interfere at all with my trip. Accordingly, I left London next morning (June 24), and reached Grimsby the same day. After some delay I had the gratification of meeting with Mr. Mudd, who, having been made aware of the object of my visit, assured me in the kindest manner that he would aid me all he could in procuring a chance to go out on a trawler. It is proper that acknowledgment should be made here of the obligation I am under to this gentleman, who interested himself to get me a berth on a good vessel, and to whose courtesy I am much indebted for any success which may have been obtained in gaining a knowledge of the beam-trawl fishery.

No trawlers were sailing that evening on which Mr. Mudd thought I ought to go, but he believed it probable some might go out the following day. He thought it would not be advisable—as my time was so limited—for me to go out on a "single-boater," which might be gone two or three weeks; neither would he advise that a cruise should be made on a cutter bound to the "steamer fleet," which at that time was working off the German coast, some 300 miles or more distant from Grimsby, since, with the prevailing light winds, the vessel might be nearly a week in reaching the fishing ground and the fleet with which she worked. The best chance for me, it was considered, would be to go out on a smack that was to join one of the small "cutter fleets" on the Dogger Bank, which would probably be reached in twenty-four hours with favorable winds; thus I might have several days on the fishing ground, observe the method of working the beam trawl, etc., and return by another vessel in time to reach Southampton and sail on the *Neckar*. The smack *Willie and Ada* was fitting out to join one of the cutter fleets. Mr. Mudd thought she would sail the next day, and he assured me I could have a chance on her whenever she went to sea. I learned, however, on the following day (which was Friday, June 25) that the *Willie and Ada* would not sail before the Monday following, because of the accidental sinking of her boat in the dock, by which mishap two of her crew were nearly drowned and rendered quite unfit, for a day or two, to go to sea. As no other smacks were sailing to the cutter fleets before Monday, either from Grimsby or Hull—as was ascertained later—there was nothing to do but to wait.

In the interim, there was an opportunity to note the various phases of the fish trade as conducted at Grimsby, which differ considerably from the methods adopted in the United States. In a previous paragraph the statement has been made that Grimsby had little importance as a fishing port previous to 1858, when beam-trawling was first introduced. And for many years previous to 1800 the harbor was practically closed to navigation by the accumulation of mud and silt at its mouth, which, in the reign of Charles 1, became so formidable "that the smallest fishing vessels could with difficulty approach the town." At present it has several large docks, two of which are exclusively devoted to the fisheries, and known as the old and new "fish docks." These have a total area of 23 acres, with a market attached (on what is locally known as the "pontoon") 1,600 feet in length; on one side of which the smacks lay and discharge their cargoes, while on the other side stand the railway cars, or "fish vans," upon which are sent away to Billingsgate and other markets the fish that are constantly arriving. These facilities for receiving, packing, and shipping fish are as excellent as they are unique, and have resulted in an increase of the fish trade of Grimsby from between 4,000 and 5,000 tons in 1858 to over 73,000 tons in 1882, while it is claimed that the population has about trebled itself, and the fleet increased from a few small smacks to about eight hundred sail of the finest fishing vessels in Great Britain.

The following statements relative to the fish trade of the port are vouched for by three of the largest firms in Grimsby, and no doubt may be accepted as correct:

"That Grimsby is unquestionably the largest and most promising fishing port in the kingdom may be seen by the following facts. In the year 1853 there were but 12 fishing vessels in this port, and no facilities for the trade whatever. At the present time there are 825 vessels belonging to the port solely engaged in fishing, with an estimated registered tonnage of 42,000, valued at £725,000, carrying 4,710 men and boys. Besides the above, the port is frequently visited by many Dutch and other fishing vessels for the sale of their cargoes. There are 50,000 tons of ice imported annually, which is not only used by the smacks at sea, but for packing in the market, and is sent in various forms to all parts of the kingdom.

"The railway company has expended nearly half a million sterling in the making of docks and otherwise providing for the fishing trade, and are still extending and ever increasing.

"From 2,000 to 20,000 live codfish, besides a large quantity of other fish, are kept ready for sale in boxes in the fishing dock. The advantages (offered to the trade) of Grimsby over other markets are found in the great variety, the constant supply, the means of storing fish alive, the many curing houses, the care and facilities given by the railway company, the superior quality by the adoption of steam trawlers and carriers, and the ready and cheap supply of ice.

"Extensive business is now carried on with the far north of Scotland, Dublin, Belfast, Carmarthen, Plymouth, Torquay, Hastings, Brighton, the Isle of Wight, Rotterdam, Hamburg, and Paris."

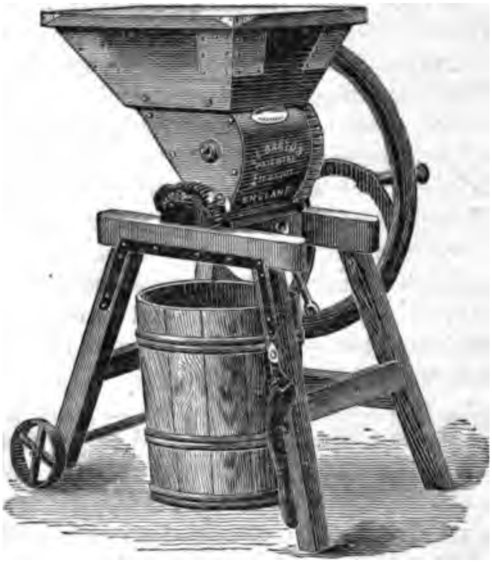


FIG. 23. ICE-MILL USED BY FISH PACKERS.

As the tide approaches nearly to its full, the dock gates are opened, which is a signal for a busy and exciting scene. All is hurry and bustle on board of the smacks that are ready for sea, and which are rapidly got under way and either sail or are towed out to sea through one of the entrances to the "fish dock," while through the other gate may be seen entering, one after the other, the vessels which have been hovering just outside—waiting for the rising tide—and whose signals and numbers have communicated to those on shore the welcome news of their arrival. Smacks from the "cutter" and "bulking" fleets, "single-boaters," steam carriers from the "steamer" fleets, long-liners, hand-liners, freighters from Norway, some with lobsters others with fresh mackerel; on they come, shooting through the narrow entrance, to quickly find their berths in dock. On the pier-heads are gathered scores of men, and occasionally women and children—if the day be fine—some waving a salute and wishing "good luck" to their departing friends, while others stand ready to give a greeting of welcome to the hardy fishermen returning, perhaps, from an absence of months. As the smacks arrive no time is lost in getting them into their respective berths, and if there be a considerable number they haul in and make fast, head on, to the "pontoon," upon which the cargoes are discharged with as little delay as possible. As the fish are taken out they are sorted according to their grades or the condition in which they arrive. For instance, the fish taken alive from the well of a smack, having first been knocked on the head to kill them, are laid out in rows according to their species, or grade, while the "boxed" fish from the trawling fleets are sold in another lot. No busier scene can be imagined than transpires here every day, and considering the quantities of fish displayed one can not help being occasionally surprised at the prices they sell for. All fish are disposed of by a number of salesmen, each of whom is empowered by contract to sell the catch of a certain number of smacks, he receiving a percentage on the sales for his services. Cod are sold by the score (that is, 20 fish), and these, with halibut and ling, are knocked off to the highest bidder; trawled fish are, however, generally sold at Dutch auction, which is thus described by Holdsworth:

"A lot of turbot, perhaps, is to be sold; the salesman's bell is rung and the stentorian voice of the auctioneer is heard calling out, 'Now then, turbot buyers, turbot buyers, turbot buyers, come along, ye turbot buyers.' A knot of people collects and the salesman descants in a few words on the quality of the fish; a price is named, no one responds, or indeed is expected to do so, for it begins too high for any dealings; it comes down by degrees until a nod from one of the crowd closes the transaction, and the sale is booked. Then calls may be made for 'sole buyers,' 'plaice buyers,' 'ling buyers,' or 'cod buyers,' and the work is rapidly got through, for there is no time to be wasted over individual lots where they are so many to be sold, packed, and sent away as soon as possible."

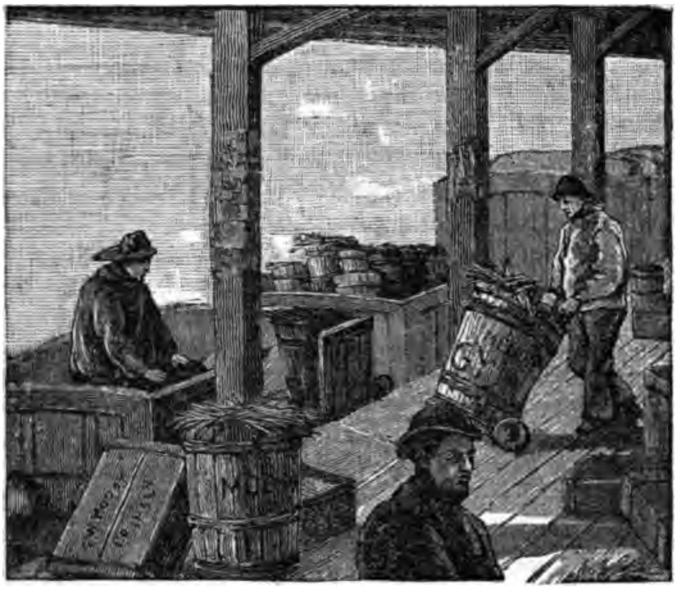


FIG. 24. LOADING FISH VANS.

They are packed with ice in crates, barrels, and in box cars, specially designed for the purpose, and shipped by swift-running trains to the various markets they are consigned to.

All arrangements for the cruise having previously been made, I went on board the *Willie and Ada*, Capt. Henry Tidder, on Monday morning. June 28, and at 9 o'clock a. m., soon after the dock gates were opened, our smack was shoved out beyond the pier-heads, all sail was set, and, with a moderate southwest breeze and fine weather, we left the Humber's mouth, passed Spurn Point, and headed away from the land toward that famous fishing ground of the North Sea, the Dogger Bank, where we expected to meet with the fleet we were to join, and where our fishing operations were to be carried on. The *Willie and Ada* was 73.68 tons register, ketch or "dandy" rigged, and manned by a crew of five, three of whom were men, the other two—the "fourth" hand or deck hand and cook—being boys of respectively seventeen and fourteen years of age.[1] The crew slept and ate in the cabin, which, considering the number to be accommodated, was roomy and comfortable, being painted and grained, but differing from the cabins of modern American fishing schooners in being under deck, and in some details of arrangement.

The wind died entirely away during the afternoon, and we lay becalmed until evening, when a moderate breeze again sprang up from the southwest. The day was fine throughout, and was spent by me in gathering information concerning the construction of the beam-trawl, the peculiarities of the vessel—so far as speed, ability in a gale, etc., were concerned—and in making sketches.

Tuesday, June 29.—The wind continued moderate during the night, but, as it was fair, the vessel slipped along easily through the water, which was so smooth that scarcely any motion could be noticed unless one glanced over the side and saw the scintillating, phosphorescent sparkle of the sea go by as we glided through it. At 5 a. m. the captain sounded and "struck the rough" on the Dogger Bank. Two hours later we spoke a homeward-bound cutter. Our skipper inquired the whereabouts of "Bascomb's lot," meaning the fleet we were to join, of which a captain by the name of Bascomb was "admiral." He was told that they were some three hours' sail—15 or 16 miles—distant in the direction we had been going. We then resumed our course, and at 9 o'clock a. m. the captain, who had been aloft at the masthead looking out for "Bascomb's lot," came on deck and reported seeing two fleets nearly ahead. We steered for the nearest fleet, which, however, did not prove to be the one we were in search of, but the skipper of one of the smacks which we hailed pointed to leeward and said: "That's Bascomb's lot, down there, I think." This proved to be the case, and soon after the order was given to our crew to: "Get up the trawl bridles and shackle them on," our skipper remarking, at the same time, "They have their gear down and I don't know how long it's been out." As we drew nearer the fleet the captain exclaimed: "Ah, there's the *Clara* with her craydon [a small flag for signaling] over her stern," and a moment later he said: "There's the admiral's flag; we'll steer for him." It may be explained that in this instance the admiral's vessel was distinguished by a flag flying on a stay extending from her bowsprit end to the main-topmast head.

---

[1] Details will be avoided, since many facts that were originally included in these notes have been given elsewhere, and also because more or less details are shown in the illustrations.

After the usual hail of, "What cheer? oh, what cheer, my hearty?" our skipper shouted the inquiry, "How long you're going to tow?" to which the admiral replied: "Oh, till about 4 o'clock."

It was then shortly after noon. A moderately brisk southwest breeze was blowing, which continued with little change during the day. After receiving Admiral Bascomb's answer we tacked and ran back to the *Clara*, which belonged to the same owner as the *Willie and Ada*, and the skipper of which had hoisted his flag at the mizzen peak as a signal that he wished our captain to speak with him. We had brought out letters, outfits, etc., for this vessel, which had been absent from port several weeks, and her captain was naturally desirous of learning the news from home, as well as to obtain some additions to his food supply. However, we did not stop to go on board of her at this time, for immediately after speaking with the admiral and learning that he would "tow till 4 o'clock," our skipper remarked: "Then we've got four hours; we'll put it out," meaning the trawl, of course. All hands were busy at work in the mean time getting ready to shoot the trawl. The bridles had been shackled to the trawl-heads, and now the towing hawser was got up and shackled to the bridles; the dandy bridle hauled off the winch, made ready for running, and bent on to the trawl-warp. While this was being done we had reached the *Clara*, and as we passed under her lee our skipper shouted: "What cheer? what cheer, my boy? I've got something for you." It seemed to be understood by the *Clara's* crew that they must wait for a more favorable opportunity to get what we had for them, and the assurance that we had "something" seemed to satisfy them for the time being.

Being curious to know if there was any choice in selecting a berth for fishing among the various vessels which formed the fleet, I asked our skipper the question: "Where will you shoot the trawl?" He replied: "Oh, any place where we can get it out." The inference is that no judgment is exercised beyond that of getting sufficient room (or far enough from other vessels) to tow the gear without danger of collision. Accordingly, a few minutes after speaking with the *Clara*, the trawl was shot from the port side. After it was down, the warp parceled and put in its proper place, so that the vessel, with tiller swinging, headed about at right angles with the wind, all hands went below and turned in for a nap except the oldest boy—commonly called the "deck hand," or "fourth hand"—who staid on deck to look out for the vessel, note the working of the trawl, and watch for the admiral's signals.

A little after 3 o'clock p. m. the boy on deck shouted that the admiral was hauling, and the crew tumbled out of their bunks, hurriedly pulled on their heavy leather boots, and, jamming their hats or sou-westers on their heads, ran on deck and began to get up the trawl.[1] The process was an interesting study for me, as I then saw it for the first time. I assisted in the work, heaving on the capstan and helping the skipper to get the dandy bridle in and the after end of the trawl-beam up to the vessel's stern.

We had been towing over ground which was more or less rocky, and which is known to the fishermen by the technical name of "The Rough," so that when they are fishing on such bottom, which they sometimes do in summer because fish are more abundant there than elsewhere, they call it "working The Rough." As a result of our "working The Rough" on this occasion, the trawl had been badly torn, which mishap was first announced while the net was being gathered in; the second hand exclaiming, in a somewhat disheartened voice: "She's all gone to smither ends!" The rip was not quite so bad, however, as was at first expected; and about 300 pounds of fish still remained in the "cod-end," which was hoisted on board, and the catch let out on deck. In this small lot there were many varieties, chief among which were turbot, sole, "cock" sole (which is a different species from the common sole, *Solea solea*), plaice, cod, hake, ling, gurnard, goosefish or monkfish (*Lophius*), besides a large number of star-fishes, anemones, sea corn (eggs of whelks), and sea pears, which, together with small rocks, and more or less sea grass and shells, made up a very interesting collection, though it was not "fishy" enough to have any special merit or attraction for the smack's crew.[2]

As soon as the trawl was emptied of its contents the (stay) foresail was hoisted and the vessel filled away by the wind, the fourth hand took the helm and was ordered to "keep her along after the fleet," which was then to windward of our vessel, working up for a new berth. (See Fig. 25.) The skipper, second, and third hands went to work to mend the net, but when this job was well advanced the mending was continued by the two former, while "Tom," the third hand, was ordered to "box the fish"; which order implied that he should dress and pack in boxes such as were marketable, about two-thirds of the lot, and throw the remainder overboard. In this instance, however, only the hake, turbot, cod, and haddock were dressed—that is, eviscerated; the others were simply washed before being packed, but were not gutted.

In the mean time the diminutive cook was actively employed in the cabin preparing supper, which all seemed glad to partake of; the ap petites of the crew having been sharpened somewhat by the vigorous exercise of heaving up the trawl.

---

[1] The *modus operandi* of heaving up a beam-trawl, as conducted on this occasion, has been described in detail in the paragraphs on methods of fishing, page 342 of this report.

[2] In subsequent hauls several other species of fish were taken, among which may be mentioned pollack (coalfish), whiting, catfish or wolf-fish, dabs, flounders, skates, etc.

Having worked to windward for about two or three hours, the trawl was shot again at 8 p. m. This time the vessel was on the starboard tack and the trawl was "shot around the stern." This was a new feature of the business, and, as the weather was fine, an excellent opportunity was afforded to note all the details. After the trawl was down the watch was set and the rest turned in.

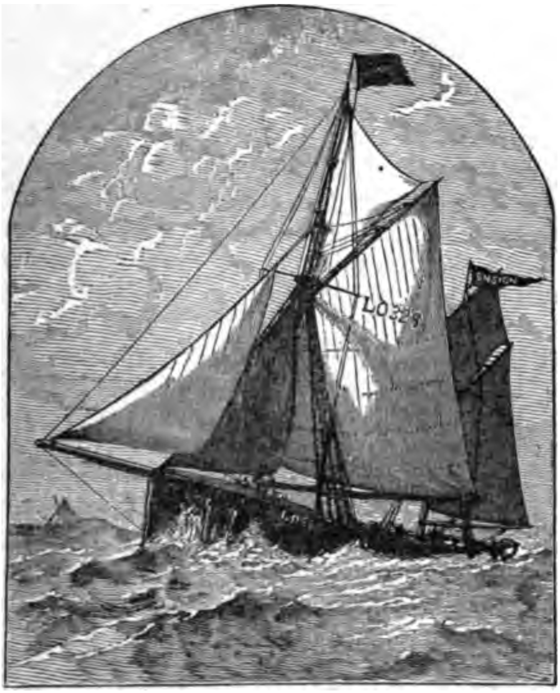


FIG. 25. WORKING UP FOR A BERTH.

Wednesday, June 30.—All hands were called out to heave up the gear at 4 o'clock a. m. I had staid up late the previous evening to gain some additional information about trawling, and to watch the fleet as the vessels worked slowly along, the bright lights of the smacks being plainly discernible in the hazy darkness of the summer's night, as the vessels rose and fell in the long undulating swell of the North Sea. Therefore, though it was bright sunlight at the time the admiral signaled to "haul trawls," I was first wakened by the skipper shouting to the tired and sleepy third hand: "You Tom! You Tom! come, rouse out here and haul!" Out we tumbled and on deck, where the cranks were already shipped on the capstan; the hatch off, and down in the hold, ready to coil away the trawl-warp, was the small boy, who not only officiates in the capacity of cook but must always be promptly on hand to assist wherever his services are required. All hands fell to with a will, the skipper tacked the vessel back and forth, " working up over the gear," while the clank, clank, clank of the capstan told that the trawl-warp was being rapidly got on board.

The catch on this occasion did not exceed over 200 pounds weight of marketable fish, though nearly everything was saved, including skate, dabs, and catfish. As in this case, however, the net had not been torn, the skipper offered, as a reasonable explanation of the small catch, the statement that there was little or no wind during much of the past night, consequently the vessel could not tow the trawl fast enough over the bottom to catch any fish—in fact, for much of the time, we had been doing little else than drifting with the tide in a calm. In the morning the wind breezed up quite briskly, and continued fresh throughout the day.

After the trawl was up, all sail was set and the smack worked to windward to join the rest of the fleet, which had not drifted quite so much to leeward during the night. Meanwhile, the fish were "boxed," and it was announced that one of the smacks, which had her "craydon" flying, would leave the fleet this morning for home, after the catch of the other vessels for the previous day and night had been put on board of her.

It is difficult to imagine a more lively and inspiriting nautical scene than was presented on this summer's morning by the little fleet to which our cutter belonged, and the center of which was the homeward-bound craft, lying to, with her flag flying. All around her were collected the other vessels of the fleet, standing back and forth under all sail, their heavy square-headed gaff-topsails aloft to catch the breeze; boats passing to and fro going to the "carrier" to take their fish, to send letters, etc., visiting other vessels of the fleet, recently out from the land (one of which was our smack), to hear the news from home, obtain letters, and secure supplies that had been sent to them. The picturesque tanned sails, gleaming blood red in the sunlight, the shouting back and forth between the crews of the different vessels as they came within hail, were additional interesting characteristics of the scene.

On our own vessel the boat had been launched stern foremost over the lee side. As soon as she struck the water one man sprang into her, and to him were passed the few " trunks" of fish we had caught, these being dropped or roughly stowed in the middle of the boat. A second man then jumped into the boat, and when the proper time arrived she was cast off and pulled away for the carrier smack to discharge the fish. "Boarding the fish," as it is called, on this occasion, when the sea was smooth and only a moderate breeze blowing, was a very tame affair compared with such work when the weather is rough. Many wonderful tales are told by the fishermen of hair-breadth escapes from drowning while engaged in transporting their fish from their vessels to the carrier, and considering that this work is done in almost all kinds of weather, one can easily believe that it is extremely hazardous, to say the least, The catch being small on this occasion the boating was soon finished, the crews returned to their respective vessels, the admiral showed his signal for sailing, and as the fleet stood off, close-hauled for the fishing ground, their companion, the homeward-bound cutter, set all sail and filled away for Grimsby.

I sent a letter by her to Professor Goode, in London, and decided to stay out until the next carrier went in.

The fleet kept under full sail, working to windward about two hours, when, at 10 o'clock a. m., the trawls were shot where the ground was rather rocky.

After towing about an hour our trawl caught afoul of the bottom, so as to stop the vessel entirely. We hove it up and found it had swept an old anchor weighing about 150 pounds that was still hanging to the net, which had been so badly torn by it that all the fish, if there were any in the trawl, had made their escape. This was rather discouraging to the crew, the members of which, however, took the matter rather cooly, and with far less grumbling than one might naturally expect, they pulled in the net and began to mend it. As soon as the repairs were completed, the trawl was put out again, but misfortune again awaited us, for in about an hour and a half it got fastened to the bottom, and it was necessary to heave it up. By this time several other vessels of the fleet were seen in the same predicament, and, perhaps on the principle that "misery loves company," our crew seemed to derive a certain sort of grim satisfaction from the fact that they were not the only ones having ill luck, and it was thought that when so many of the fleet met with this mishap the admiral would lose faith in "working The Rough."

When it was up, we found the trawl badly split; indeed, in this instance, it would have been no exaggeration to say it was "all gone to smither ends"; and five or six plaice, that were jammed in the pockets, constituted its entire contents. The skipper, second and third hands turned to again to repair damages, and as the rest of the fleet hove up their gear about the same time, we all filled away and stood along by the wind until 8 p. m., when, in obedience to the admiral's signal, the trawl was shot in 20 fathoms. We had previously fished in from 18 to 25 fathoms, and for the most part, as has been indicated, on rough ground.

Capt. Tidder believes that little can be done "working The Rough," even where fish are comparatively plenty, since the gear is liable to much damage, and may possibly be rendered entirely useless. Spare trawl nets, beams, heads, etc., are carried on the smacks to replace losses which may occur, but it is evident that should these be unusual even all the spare gear may be destroyed and the vessel compelled to leave the ground and go in for more. This rarely happens, so far as could be learned.

The day was spent by me, like its predecessors on this trip, in taking notes and making sketches, varied by assisting the men to heave up the gear, and steering when it was necessary for all the others to be at work.

Thursday, July 1.—At 3.45 a. m. the watch came below, called the skipper, and told him that the admiral was hauling. As the skipper tumbled out of his berth he gave a quick glance around to see if all of the crew were up. His eye rested on the third hand, who, having been on watch all the first part of the night, was naturally very sleepy, and was still slumbering in profound unconsciousness of the admiral's order. But the sleeping man was quickly brought to a realizing sense of the situation, and swarmed out of his berth in obedience to the order of the skipper, who shouted in stentorian tones: "You Tom, here; rouse out here and haul the trawl." All hands were on deck and at work in a remarkably brief space of time. No minutes are wasted in preparing for the day's duties; there is no stopping to wash, not the faintest attempt at personal cleanliness, even the boy cook is begrimed with coal dust, smoke, and soot; it is evident that little is thought of refinement, even such as may be obtained from a dip in a bucket of salt water. The main idea is *to catch fish*, and the toil and hardship incident to this vocation, the necessity that always exists for tumbling out "all standing," and rushing on deck, serves to make these men—as well as all other fishermen, the world over—rather indifferent while fishing to the simplest forms of neatness, which to people on land are considered indispensable.

When, in obedience to the call to work, as on this occasion, the half-wakened fisherman springs out of his bunk to the cabin floor, he realizes, first of all, the necessity of getting on deck with the least possible delay; therefore, with eyes still half closed, he gropes for his boots, pulls them on, snatches his hat from some convenient place where it has been put, and jams it on his head. This, if the weather be fine, completes his equipment, but, if it is stormy, oil clothes are also donned. In either case, the least possible time must be occupied, and frequently the men are not fairly awake until after they reach the deck.

When the end of the trawl-warp was inside the roller, the skipper looked over the vessel's side and exclaimed, "She's capsized again!" meaning that the trawl was upset, which he could easily tell by the bridles being crossed.

It was explained by the skipper, in answer to my inquiry, that the capsize was caused by the vessel, when working up to the gear, bringing the warp taut in the opposite direction from which the trawl was being towed over the bottom. This turned the trawl over on its back, bringing the beam underneath, and a twist in the bridles, since the forward end of the beam is aft; the position can therefore be told as soon as the upper ends of the bridles are in. The dandy bridle was cast off the trawl-warp, and a stopper put on the after bridle, which was then unshackled. By passing the ends of these around the forward bridle, outside of the smack's rail, the turns were taken out so that they led clear.

The dandy bridle was then taken over the taffrail (through the chock) and led to the dandy winch; when the bridle was hove taut and the trawl beam turned end for end and swung into its proper position, after which it was hove up in the usual way.

The catch of fish was small this morning, amounting only to two trunks of plaice, one trunk of mixed fish—cod, small haddock, skate, a conger eel—and one or two turbot in number, a little over 300 pounds weight in all. The fishermen agree in saying that the catch so far this trip is unusually light, though at this season fish are generally scarce in this region. They tell of catching 4,000 and 5,000 pounds of fish a day, and mention instances when as many as 10,000 pounds have been taken at a single haul, the species captured on these occasions being chiefly haddock.

When the trawl was up we "made sail"—that is, got under way—and stood along a short distance to join the rest of the fleet now gathered around the smack *Sobriety*, which was the next to sail for Grimsby. The morning's catch of the fleet was put on board of her, and I learned that she would sail the next day for market, providing fish enough were taken in the mean time to complete her cargo.

There was a brisk northerly breeze in the morning with light rain, but the wind moderated considerably during the forenoon and it stopped raining about 9 a. m.

At 11 a. m. we shot the trawl around the stern in 19 fathoms of water and towed away to the westward on the starboard tack. At 4 p. m. the gear was got on board again, and about 200 pounds of fish were found in the trawl, most of which were plaice.

We then stood along by the wind on the starboard tack, heading about northwest, until 8 p. m., when the trawl was shot for the night, the vessel still heading westerly. On this occasion the trawl-warp was taken around the smack's bow instead of being hauled under her bottom, as it formerly had been. This was done to prevent it from being chafed, also that it might be in a position to bring the vessel in stays in case we met with other smacks during the night towing in an opposite direction.

Friday, July 2.—A little after midnight—about 12.15 a. m.—I was awakened to see the vessel wear around while towing the trawl.[1] The object of this maneuver is generally to change the tack with the turn of the tide, and thereby tow the trawl back nearly over the same ground it passed across during the first of the night. Or, perhaps, as on this occasion, it is done to keep clear of rough bottom, which the lead gives warning of. A smack can, of course, be tacked around with the trawl out, as has been mentioned, and this can be done quicker and easier than to wear, but unless the conditions are favorable the trawl is very liable to be upset.

---

[1] The manner of "wearing a trawl around" has been described in the chapter on Methods of Fishing.

There was a brisk westerly breeze in the morning with fine clear weather, but later in the day the wind moderated slightly and there were light showers of rain in the evening.

The trawl was hauled at 5 a. m. and, though it was torn considerably, there were about 1,200 pounds of fish in the "cod." These were chiefly small haddock, such as the New England fishermen call "scrod" haddock. According to the skipper, we "struck The Rough" about half an hour before we began to heave up the trawl, which accounted for its being torn.

Most of the vessels in our fleet got fair catches of fish this morning, compared with what they had previously taken, and not a few of them had their nets torn. After the trawls were up, and while the crews were busy dressing and boxing the fish and repairing damages to the gear, the fleet filled away and beat to windward to regain the position where they began fishing last evening. The catch was not sufficiently large to complete the cargo of the *Sobriety*, and consequently she did not start for market to-day. But I concluded, however, to change my quarters, and when the boat left the *Willie and Ada* to transfer the morning's catch of fish I went in her, on board of the *Sobriety*, where I was welcomed by the captain and crew, and where I staid for the remainder of my cruise.

It was an interesting sight to witness, from this point of view—on board of the carrier—the various phases of boarding the fish which have been alluded to elsewhere. Along the lee side of the *Sobriety* were crowded the boats of the fleet, the crew of some of them actively engaged in getting their fish on deck, upon which was gathered a group of hardy fishermen belonging to the other vessels, and who, now their fish were on board and their boats dropped astern, were interchanging news, chaffing the newcomers, and apparently enjoying this break in the monotony of their lives on board their own vessels.

The crew of the cutter which takes the fish in generally have to stow the boxes below and ice them, putting down alternate layers of trunks of fish and ice, the latter being ground fine in a mill which each smack of the fleet is provided with. Sometimes the carrier's crew receive assistance from the men belonging to the other vessels, who, after they have discharged their boats and deposited their bills of lading in the companion, lend a hand to get the trunks below deck. When, however, all the vessels in a "cutter fleet" are sharing alike, each receiving an equal portion of the catch, no tallies are put on the trunks of fish and no bills of lading are needed.

At 1.30 p. m. the admiral signaled to "shoot the gear," and accordingly the trawl was put out. But it got caught up on the bottom soon after it was down, and we had to heave it up and repair the damage which the net had sustained. As this took some time it was decided by our skipper that it would scarcely pay to make another shot during the afternoon, and as several other smacks met with a similar mishap, and none of them put out their gear after repairing it, they all gathered around a vessel just out from home, and the skippers went on board of her to learn the news and inquire for letters. As our captain was going, too, I joined him and spent two or three hours very pleasantly, learned some new facts about beam-trawling, and was gratified to find the fishermen communicative and intelligent, many of them possessing a comprehensive knowledge of the business in which they were engaged, and some having considerable general information.

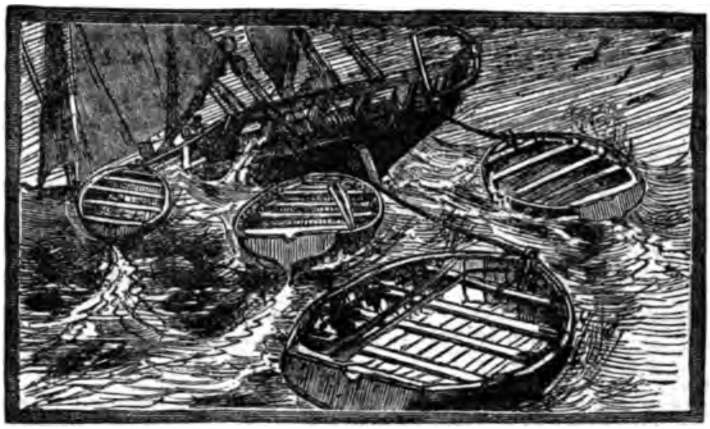


FIG. 26. VISITING.

I did some sketching to-day, but, owing to the prevalence of rainy weather since the cruise began, there have been few opportunities for securing sketches.

Saturday, July 3.—There was a fresh southwest breeze in the morning—a head wind for Grimsby, which materially decreased my chances of reaching Southampton to join the *Neckar*.

We began to heave up the trawl at 2.30 a. m., and at 5 o'clock it was alongside. About 800 to 1,000 pounds of fish were taken on this haul. After the trawl was up the smack filled away, and stood along to the westward, by the wind, with the rest of the fleet in company, until the fish were ready to put on board the *Sobriety*, when we hove to and waited for the morning's catch to be "boarded."

Several of the skippers, among whom was Captain Tidder, came aboard the *Sobriety* to bid me good-bye, and to wish me a safe and speedy passage home. From all of these men I received uniform kindness and courtesy, while they have shown a willingness to give me all the information possible concerning their vocation.

As soon as the fish were all aboard our guests took their leave, our smack filled away, all sail but the jib-topsail was set, and we headed along about west by south, close-hauled on the port tack. When the fish were all below and iced the bobstay was hooked on and hove taut, and the jib topsail set. This was at 11 a. m., at which time the wind was moderating, and it gradually decreased until it finally fell calm in the evening.

Sunday, July 4.—Began with light northerly breeze and drizzling rain. Wind increased, at 4 a. m., to a fresh breeze, and after 11 a. m. it blew strong and squally.

At 4.30 a. m. we made the land a short distance north of Flamborough Head, which is 30 miles from Grimsby, and at 11 o'clock we passed Spurn Point. After rounding the point we took in the gaff-topsails and big jib, set the small jib, and took a reef in the mainsail and mizzen, thus putting the vessel under easy sail to wait for the rising tide to reach its full. No vessel can enter the Grimsby docks until the signal is hoisted—an hour or so before high water—which, on this occasion, was displayed a little before 2 p. m.

In the mean time we lay by off the harbor's mouth, slowly reaching back and forth in company with several other inward-bound vessels. Shortly after the signal was run up we shot into the dock, and the *Sobriety* soon lay securely moored in her berth, ready to discharge on the following morning.

I immediately sent a telegram to Professor Goode, acquainting him with my arrival at Grimsby, and stating the hour when I should be in London on the following day.

In the evening I called on Mr. Mudd and informed him of my return and of the success which had attended the cruise.

Monday, July 5.—I reached London at noon, and joined Professor Goode; the same evening we arrived at Southampton, in ample time to secure our berths on the *Neckar*, which was expected the following day.

II.—*NOTES ON THE BEAM-TRAWL FISHERY OF CONTINENTAL EUROPE.*

A. FRANCE.

Though beam-trawling is prosecuted to a considerable extent by the French, this fishery has not assumed, in France, anything like the important proportions which it has attained in Great Britain. No statistics are available showing to what extent the beam-trawl fishery has been carried on in France; but when it is stated, on the authority of Mons. A. Duchochois, of Boulogne, that only twenty-five sailing trawlers go out from that important fishing port, and that France has no steam trawlers, some idea may be gained of the status of this fishery.

1. FISHING GROUNDS.

The fishing grounds of the North Sea and the English Channel are visited by the French trawlers, in common with the English, though it is probable the former keep nearer the continental coast than the English do.

2. Vessels.

Smacks are used for beam-trawling; these carry crews of eight men each. Some of them are ketch-rigged, but others are cutter-rigged, carrying only a single mast.

3. Apparatus.

The beam-trawls used by the French have the same general features as those employed by the English, which have been fully described.

"In the French trawls the net is very much shorter in proportion to the length of the beam; it tapers regularly to the end, has no distinct cod, as in the English nets, and the rubbing pieces extend across the under side of the trawl for some distance from the end, which is specially protected from chafing by having a stout hide underneath."[1]

The ground rope is sometimes weighted with chain that is fastened to it in festoons, similar to the plan adopted by Belgian fishermen.

The same pattern of head-iron that is used by the English is also, I am informed, now most generally adopted by French fishermen. At the time Holdsworth wrote, other forms were in favor in France to a considerable extent, though he mentions that even then the Brixham pattern was used.

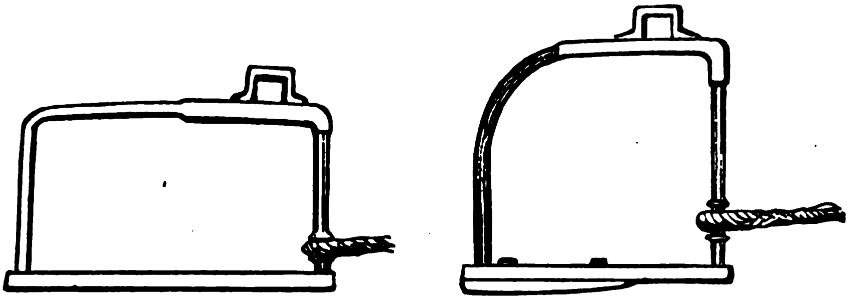


Fig. 27. Fig. 28.

French Trawl-heads (after Holdsworth).

Concerning these peculiar forms of trawl-heads he writes as follows:

"Among other varieties of trawl-head may be mentioned those we have found used by some of the French trawlers, and the noticeable feature in them is that the beam is placed so near the front of the head as to require the tow-rope to be fixed very low to prevent the fore part of the shoe burying itself in the ground. This is further guarded against in one variety [see Fig. 27] by the additional length of the frame behind the beam. There appears to be a want of balance in these French irons which is not the case with those used by our own fishermen. No doubt there is some degree of fancy in the shapes adopted; but the English irons strike one as better adapted for their work, and the Brixham pattern is now being much used by the French trawlers. By means of these irons the trawl-beam is kept nearly 3 feet above the ground, so that it neither touches nor causes any disturbance of the bottom whatever; its sole use is to extend the mouth of the net, and if it were to touch the ground, as many persons believe it does, it would effectually frighten away the fish and prevent their going into the net."[1]

---

[1] Deep Sea Fishing, etc., p. 61.

4. METHODS OF FISHING.

The methods of fishing, so far as shooting and hauling the trawl are concerned, are essentially the same, according to M. Duchochois, as those adopted by English fishermen.

B. BELGIUM.[2]

According to M. Jules Le Lorrain, there are about 222 vessels employed in the beam-trawl fisheries from Belgium; 170 of these sailing from Ostend and the remaining 52 from Heyst and Blankenberghe. There are also 22 small boats, commonly called "sloops," engaged in this fishery on the Belgian coast. The foregoing will give an idea of the importance of the trawl-fishery of Belgium, though it should be stated that some of the vessels do not, like the English, pursue this business throughout the year, but frequently engage in other branches of the fisheries.

1. FISHING GROUNDS.

The fishing grounds resorted to are essentially the same as those upon which the English pursue their work in the North Sea.

2. VESSELS.

The vessels employed in beam-trawling from Belgium are of two classes. The larger and more important type so closely resembles the English ketch-rigged trawler that the description given of the latter will apply as well to the Belgian smack, which differs from the other chiefly in having less rake to her stern-post, and, perhaps, in a less elaborate equipment for working the gear. A capstan exhibited in the Belgian section at London was of the old-fashioned type, and as this was intended to represent the kind used for heaving up beam-trawls, it is evidently far less effective than the improved and powerful capstans carried on English trawlers.

The other class of Belgian trawlers are large, open, clinker-built boats, very wide, with round bilge and flat bottom. They have a peculiar lug rig, average about 20 tons, and, like the "*bomschuiten*" of Holland, are specially designed for fishing from a coast where harbors are not easily accessible.

---

[1] Deep Sea Fishing, etc., pp. 57–58.

[2] The statements made here relative to the Belgian beam-trawl fisheries are based partly upon a study of models of vessels and full-sized apparatus exhibited at the International Fisheries Exhibition, London, 1883, and partly upon information very kindly furnished by Mons. Jules Le Lorrain, of Belgium.

The vessels sailing from Ostend carry each six men in a crew, while four men is the average crew on the Heyst and Blankenberghe trawlers.[1]

3. APPARATUS.

In most essential particulars the trawls used on the larger class of Belgian trawlers are constructed on the same general plan as those employed by the English.

There are some differences, however, in details, as may be gathered from the following description of a trawl exhibited in the Belgian section at London.

The foot of this net was first hung to a small hemp rope about the size of ordinary nine-thread ratline stuff. This small rope is seized, at intervals of six inches, to a larger hemp rope—about 1¾ inches in circumference—and the latter is fastened, by galvanized iron-wire seizings, to the foot-rope proper, which is 4¾-inch manilla. Attached to the ground rope, by stout iron rings, are festoons or loops of chain, the rings being 6 inches apart and there being five or six links of chain in each loop. Fig. 29 is a section of the foot of a Belgian trawl, and shows this peculiarity of construction. This chain attachment is for the purpose of making the ground rope "bite" the bottom; that is, dig into it so as to disturb any flat fish, like soles, for instance, that cling close to the ground and partially bury themselves. One would think, however, that this plan might be objectionable, because if the ground rope should be caught up on rough bottom, it seems probable that the trawl-warp would part before the chain, and, consequently, the whole gear would be lost.

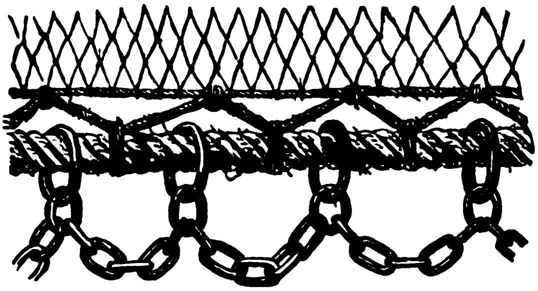


FIG. 29. FOOT ROPE OF BELGIAN TRAWL.

The Belgian trawl-head (Fig. 30) has very nearly the same shape as the head-irons used by the Hull and Grimsby fishermen, differing chiefly from the latter in the after part of the curve, from the beam to the shoe, being of round iron instead of flat, and in having the eye for the ground rope to bend into inside of the lower after corner instead of forming a projecting ear behind as in the English trawl-head referred to, though in this respect it is similar to the (English) "Barking pattern."

---

[1] Since the above was written steam trawlers have been built in Scotland for the Belgian fishery.

The end of the beam projects several inches beyond the socket and is held in place by a stout iron key. Iron wedges are not used to secure the beam ends, as is customary in England.

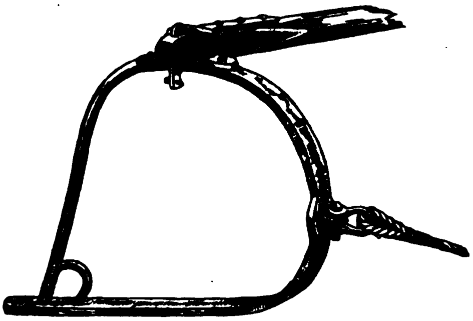


FIG. 30. BELGIAN TRAWL-HEAD.

The following are the dimensions of the trawl-heads exhibited at London: Height (inside) or vertical diameter from top of shoe to lower part of beam, 2 feet 6½ inches; horizontal diameter, 3 feet 6 inches; shoe, 4 inches by ⅞ inch iron; front of head, 3 inches by ⅞ inch iron; back, 1½ inches diameter.

The bridles were of four-stranded, 6½-inch manilla rope.

The trawl used on the smaller craft, and which is pulled in by hand or by means of a small winch, is of a peculiar pattern, so far as the beam and trawl heads are concerned, the net itself having the same general appearance which is characteristic of this form of apparatus. The following is a description of one of these trawls exhibited at London:

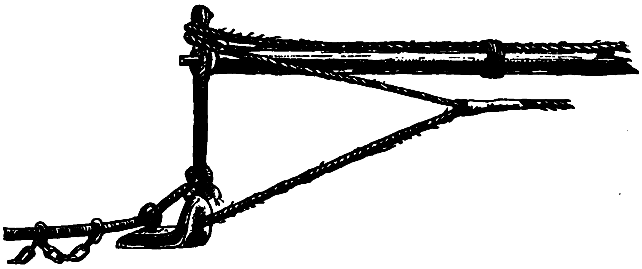


FIG. 31. TRAWL-HEAD, BEAM, ETC., USED IN-SHORE.

The beam was 21 feet long and 4 inches in diameter. In each end of it was fixed an iron bolt 3 or 4 inches long, which passed through a hole in the top of the head-iron, and was prevented from getting out of its socket by a rope which was tightly stretched along the top of the beam and fastened at each end to the top of the head-irons, one end of this rope being hauled tight by a small lanyard rove through roughly-made bulls-eyes. The head iron is of a peculiar pattern, and an idea of its form can best be obtained from the illustration, Fig. 31. A broad lower part or sole curves up in front like the runner of a sled, but about 6 or 8 inches above the ground the "shoe" is joined to a round bar of iron, 2 inches in diameter, which at the top is flattened slightly and perforated with two holes, one for the beam iron and the other for the head rope. On the upper side of the sole or shoe is an eye, through which passes the ground rope, the end of which makes fast to the round part of the head iron. The sole is 1 foot long where it rests on the ground, made of 4 by 2¼ inches flat iron. The head is 3 feet 3 inches high to the extreme top; the beam is raised about 2½ feet above the ground. The ground rope of this trawl is fitted with chain festoons in the same manner as the larger Belgian trawl.

In order to make this tow over the ground without upsetting, a short bridle or span is attached to each head iron; the lower part of this bridle (which is 4 feet 3 inches long and well parceled to prevent chafe) passes through a hole in the front part of the shoe 5 or 6 inches above the ground, being knotted on its end to prevent it from coming out; the upper part (3 feet 8 inches long) fastens around the head above the end of the beam. Beyond this span the bridle proper extends to the towing warp.

4. METHODS OF FISHING.

The methods of working the trawls on the larger class of Belgian vessels, according to M. Lorrain, are the same as those employed on the English trawlers.

The "single-boating" system is the only one followed, each vessel taking its own catch to market. Ice is carried for preserving the fish. The smacks from Ostend usually make trips of eight to ten days in length, while the Heyst and Blankenberghe craft rarely stay out more than one or two days. The fish are packed in boxes on board the vessels and brought to market in baskets. All the fish caught by the Ostend boats are sold at that port and from thence they are distributed by the dealers.

C. HOLLAND.

The fisheries of Holland are of a mixed nature, differing from those of most English ports in that the same vessels which follow herring fishing for a portion of the year may at other times engage in beam-trawling, or the beam-trawler of to-day may be employed in fishing with long lines to-morrow. It is therefore somewhat difficult to say precisely what is the relative importance of beam-trawling among the fisheries pursued by the Dutch. That it is an important branch of the fisheries of Holland is well known.

"Next to the herring fishery," says a Dutch writer, "the capture of fresh fish is the principal one in Holland. The fish are sometimes caught with hooks, but more frequently with trawls and other drag-nets. In this fishery all the '*bomschuiten*' of the coast take part during the winter, and some of the luggers which carry on the herring fishery in summer; also the fifty large vessels referred to above (as being employed a portion of the year in fishing for cod with lines), and all sorts of other vessels, great and small, hailing from the small towns along the coast."[1]

Assuming that there is probable truth in the belief held by some writers that the use of beam-trawls was first made known to the English fishermen by the Dutch who accompanied the Prince of Orange to England in 1688, there is reason to believe that this system of fishing has long been practiced by the Netherlanders.

1. FISHING GROUNDS.

While the larger vessels commonly fish in the North Sea, the "*bomschuiten*" usually carry on their work not far from the Dutch coast. Genrally the Dutch vessels resort to many of the same grounds for trawling that are visited by the fishermen of the countries previously mentioned.

2. VESSELS.

The larger class of vessels employed in beam-trawling are, as has been said, generally employed in herring fishing during the season when herring are most abundant in the North Sea. As the herring fishery is, par excellence, the most important of all the Dutch fisheries, the vessels are constructed and rigged with especial reference to their fitness for catching herring, while their adaptability to beam-trawling is, in most cases, considered of secondary importance. These vessels—the so-called luggers, or loggers—range from about 45 to 70 tons; they are not so sharp forward as the British smack; are nearly of the same relative proportions as to length, breadth, and depth, being possibly not quite so deep as the English craft. They are flush-decked, ketch or yawl rigged, and generally with mainmast arranged so that it can be lowered. They have an ordinary capstan that stands well aft—so as to be out of the way of the nets when herring fishing—and the trawl-warp leads over the side abreast of this capstan. The winches, "dummy," etc., that form a part of the deck equipment of a first-class English trawler, were not attached to the models of Dutch vessels exhibited at Berlin, 1880, or London, 1883; therefore it may be assumed that these are not used.

The "*bomschuiten*" are a peculiar class of smaller fishing craft, designed especially for use on parts of the coast where harbors are not easy of access or where there are no harbors. They are made extraordinarily wide, being about two-thirds as broad as long, while the bottom is flat and constructed with especial reference to being hauled out on a beach or again launched through the surf. They are clinker-built, usually about 30 feet long, both ends shaped nearly alike, rounding yet almost square on top; have flush decks, and each carries a large capstan near the stern that is the motive power for getting on board two trawls which they use. They have a peculiar sort of yawl rig, supplemented occasionally by a small square topsail on the mainmast.

---

[1] Introduction to the official catalogue of the Netherlands exhibit at London, 1883.

3. APPARATUS.

The beam-trawls commonly used by the larger class of the Dutch vessels are about the same in all essential details as those used by English fishermen.

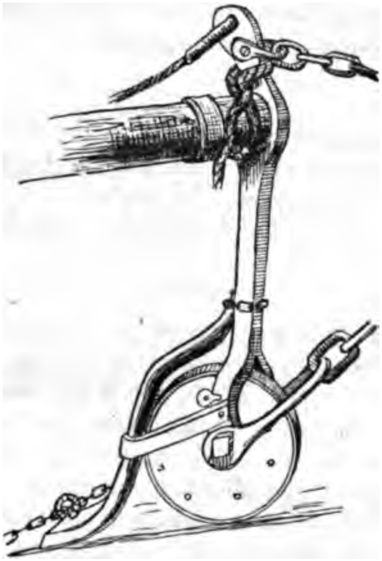


FIG. 32. GROEN'S TRAWL-HEAD.

A peculiar form of trawl-head iron, Fig. 32, was exhibited in the Netherlands department at London, 1883, by W. Groen, of Scheveningen. This was the invention of the exhibitor, and was attached to a trawl-net designed for sole fishing, such as is used by the *bomschuiten*, and which it is desirable to have pass easily over the ground. The idea is somewhat similar to that of de Caux's, but is less elaborate.

This trawl-head is somewhat difficult to describe. The upper part is a square bar of iron, forked at the lower extremity to fit over the wheel, and having holes through the extremities for the axle of the wheel to pass through; the upper part of this iron is bent slightly backwards and broadened out somewhat to admit of holes being made in it, one for the end of the trawl-beam iron and others for the bridle shackle and head rope. To the rear lower part is welded a sort of foot, recurved, extending over the back of the wheel and resting on the ground behind, being held in place by a stout U-shaped iron clamp which passes around it and each end of which is bolted to the prongs of the head-iron, a little above the wheel axle. At the extremity of this foot, on top, is an eye for the ground rope of the trawl to pass through. The wheel itself is of hard wood, banded with iron, and at equal distances around it, near the edge, are a number of holes. These holes are so placed for the purpose of stopping the wheel from revolving, if deemed desirable, by shoving a key through the prong of the iron into any one of the holes that chances to be uppermost. A large shackle, one end of which is connected with the wheel by the axle bolt, comes in front of the wheel, and from this and the shackle at the top of the iron extends a short chain span that connects with a shackle at its end, to which also the bridle is attached. The following are some details of the measurements: Total height, 3 feet 1 inch; diameter of wheel, 11½ inches; thickness of wheel, 5 inches; size of iron between wheel and beam, 1½ by 1½ inches; hole for beam iron, 1¾ by ⅝ inches; lower part of foot is quite flat, 3¼ by ⅝ inches; lower chain bridle, from axle of wheel, 2 feet 8 inches; upper bridle, 1 foot 10 inches.

In this case a flat bar of iron is fitted into the end of the beam (which is banded to prevent its splitting), and this iron, projecting beyond the beam, slips into an oblong hole at the upper part of the trawl-head.

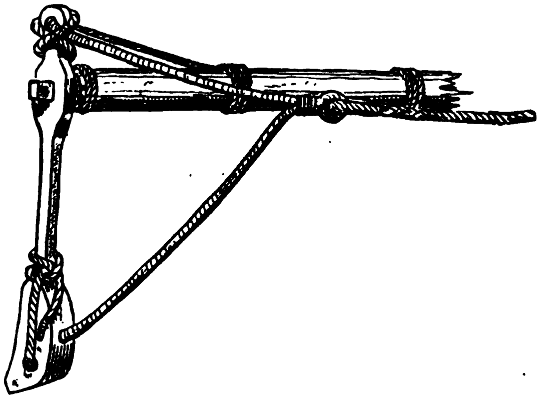


FIG. 33. DUTCH TRAWL-HEAD.

The trawls ordinarily used by the *bomschuiten* have some peculiarities. The following is a description of one of these trawls, exhibited at London, 1883: The beam is made of soft wood, 25½ feet long, 3¾ inches in diameter, backed by a square iron bar ¾ inch square, which is seized to the beam. Projecting from the beam ends are iron bars which pass through the holes in the top of the head-irons. The head-iron is 3 feet high; it is straight, small at the top, but with a heavy square foot that is 10 inches high and 4 inches square, rounded on the lower front part so that it will slip over the bottom. (See Fig. 33.) Through this foot are two holes, one about in its center, from front to rear, for the lower part of the span to pass through, and the other transversely, near the lower extremity, for the ground rope to reeve through. The whole affair is simple and primitive. A rope span extends forward from the head, a large thimble being seized in its bight, and into this thimble is bent the bridle. One end of this span fastens to the upper part of the head-iron, and is 2 feet long; the other or lower part of the span is 2 feet 7 inches long, and passes through the foot of the head-iron and is held by a knot on the end of the rope.

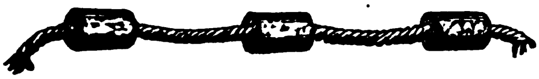


FIG. 34. SECTION OF FOOT ROPE.

The ground rope is in striking contrast to those used by British fishermen. It is a small-sized hemp rope, scarcely larger than an inch, and on it are strung, at distances of 3½ inches between each two, a number of lead sinkers, these being 1½ inches long and 1 inch in diameter, with holes through them sufficiently large to admit the rope. (See Fig. 34.) The net itself does not differ materially from other trawl-nets.

4. METHODS OF FISHING.

The methods of fishing with beam-trawls on the larger Dutch vessels are essentially the same as those adopted by the English, so I am assured by Mr. A. E. Maas, of Scheveningen. Holdsworth says: "The same method of fishing is general on the coasts of Holland, Belgium, and France; but the Dutch are peculiar in using two trawls at once, one being towed from the bow and the other from the stern of the vessel."

It is a question, he thinks, whether, taking the year through, much advantage is gained from this system, although undoubtedly large catches are made by it sometimes. It is possibly true that, at the time Holdsworth wrote, the Dutch were not using the large beam-trawls—a single trawl to a vessel—as they now do in the North Sea. His remark on the system of trawling pursued by the fishermen of the Netherlands applies more particularly to the "*bomschuiten*," all of which, according to Mr. Maas, still use two trawls—each with a beam about 20 to 21 feet long, of the kind last described—one of which is put out from the stern and the other from the bow. The peculiar construction of the "*bomschuiten*" makes it possible for them to operate two trawls, though this might be found impracticable and unprofitable on vessels of the ordinary form. The "*bomschuiten*" are so modeled that, when their lee-boards are up, they have a minimum of lateral resistance; therefore, when towing their gear, they slide off almost dead to leeward, drifting very much faster, of course, than a deeper vessel would. With a fresh breeze of wind and a lee tide effective work may be done, but with the tide running to windward it is difficult to understand how these boats can work to advantage.

All of the Dutch vessels take their own catch to market, and are what would be termed "single boaters" in England. The "*bomschuiten*" rarely stay out more than a day or two, but the larger vessels make longer cruises, in most if not all cases bringing in a portion of their fish alive and the rest in ice.

D. GERMANY.

Though trawling in various forms is quite extensively prosecuted by the Germans, beam-trawl fishing proper has not assumed very important proportions as compared with this fishery in some other countries.

1. FISHING GROUNDS.

The German trawlers fish chiefly, if not wholly, in the North Sea, but, as a rule, not far from their own coast. As the shore soundings off the west coast of Prussia constitute some of the best of the North Sea fishing grounds, more especially in summer, there is no need for the German vessels to go such long distances from home ports as the English trawlers often do. But, since the larger trawling vessels often market their catch at English ports, they are placed in essentially the same position as the British trawlers, so far as nearness to fishing grounds is concerned. The small craft, of course, fish quite close to the land, but the larger vessels often go some distance off when the inshore fisheries are not profitable.

VESSELS.

Among the most important types of beam-trawlers from Germany may be mentioned the luggers or "loggers" of Emden, and a peculiar ketch-rigged class of vessels that have been designed by Blankenese builders. The first named of these were, like many of the Dutch trawlers, originally designed for the herring fishery, and, in fact, were either built in Holland or modeled after the vessels of that country. They are about 60 to 70 tons, rather full, flush-decked, and ketch-rigged, the lower masts being somewhat longer than those of the English smack, and the mizzen-mast a trifle farther forward.

The Blankenese-built vessels are of a similar rig, but are sharper, and provided with a well for keeping their fish alive. The striking peculiarity of this type of craft is the shape of its bottom. Though a keel vessel, the lower part of the bottom, which is about half the width of the deck, is nearly flat and sharp at each end, like the bottom of an American dory. This flat section has flaring sides, that are 2 to 3 feet high, and which are joined to the upper part of the hull, that is shaped like the top of an ordinary vessel. It is claimed that these vessels are swift and seaworthy, and that they have the special qualification of keeping their fish alive much longer than they can be kept in round-bottomed smacks.

Several forms of sharp-sterned decked boats are employed in trawling along the German coast, though this can not in any way be called beam-trawling since the apparatus has no beam attached to it, and is most commonly operated by two boats working together, in a manner precisely similar to the method practiced by the Spanish fishermen for working the large "bou-net."

3. APPARATUS.

The beam-trawls used on the German vessels are the same as those employed by English fishermen, the latter having been taken as the standard.

4. METHODS OF FISHING.

The methods adopted by the Germans are like those of the English, as might naturally be expected, when it is stated that fishermen from the east coast of England have been employed by German firms to act in the capacity of experts or instructors in this branch of the fisheries.

The vessels fish singly, each marketing its own catch, and on some occasions the fish have been sold in English ports.

E. SPAIN.

The use of the beam-trawl in Spain is, I think, of recent date, though other forms of trawls or drag-nets have long been employed in that country.

One of the most common forms is worked by two boats, each of which is attached to and tows one wing of the net. This is used extensively on the Mediterranean coast of Spain. It is called a "bou net," or, sometimes, a "parella," or "parenzella."

Of late years, however, several screw steam trawlers have been built in Scotland for the Spanish fisheries. These are owned at San Sebastian. They are fine, seaworthy, ketch-rigged vessels of 35 to 70 tons and well adapted for beam-trawling, which they carry on chiefly in the Bay of Biscay.

1. THE "BOU NET" OR PARELLA.

It is believed that the "parella," which is probably identical with the Italian parenzella, was invented in the sixteenth century. This name, according to Captain Commerma, means a pair in the Catalan language. It is applied to a plow that two oxen are required to work, and likewise to this net, which is towed by two boats. The net has two long arms or wings, the lower edges of which are weighted with small sinkers, while the upper edges are raised from the bottom, and, consequently, the mouth of the net is kept open by a number of cork floats. The arms are 130 meshes, or about 3½ fathoms deep (the size of mesh being 2 inches) and 7 fathoms long, the cork rope and ground rope having nearly the same curve; the body of the net, from where it is joined by the wings, tapers so as to form a cone 11 yards long, which is joined by a small neck to the end, the extremity of which is flat and spread out considerably: this end corresponds to the "cod" of a beam-trawl. To the end of each wing is attached a towing span, a double rope, distended in the middle with a wooden spreader or cross-bar, one bight of which is secured to the extremity of the wing and the other bight having an eye for the towing rope to bend into. These nets are used in different depths, sometimes in as much as 100 fathoms. The towing warps are about 300 fathoms long. When the boats are towing the "parella" they keep at a distance of 400 to 500 fathoms from each other, so that the arms of the apparatus will be well extended that they may sweep a wide area of sea bottom.

The following are the dimensions of the "parella" as given by Captain Commerma: Total length, about 30 fathoms; length of arms, each, 7 fathoms; width of arms, about 3½ fathoms, or 130 meshes; size of mesh in arms, 2 inches; size of mesh in body of net, 1 inch and ¾ of an inch. The lead sinkers weigh about 1 pound each, and are placed 18 inches apart on the ground rope.

The "parella" is used from October 20 to Easter Monday, during which season the various species of fish that occur near the bottom in the Mediterranean are captured.

Captain Commerma is authority for saying that the "bou net" is used by steamers on the north coast of Spain, two steamers towing the net. Trawling in this manner is, however, carried on only to a limited extent in the north of Spain, but very largely in sail-boats in the Mediterranean.

III.—*ATTEMPTS TO USE THE BEAM-TRAWL IN THE FISHERIES OF THE UNITED STATES.*

Several attempts have been made to use beam-trawls in the fisheries of the United States, as detailed in the following statements, and it is quite possible that similar trials have been made by other parties which I have no knowledge of. It will be noticed that the attempts alluded to here resulted in failure. The trial made off Cape Cod could scarcely be called a fair test of the apparatus, while Mr. Booth holds the opinion that a longer practical test in the lakes, by a competent expert, might lead to far different results from those which he obtained in his experiment.

The following are the facts relative to the trials which have been made:

Capt. Sylvester Walen, of Boston, Mass., states that about 1864 Capt. Richard Leonard, a native of Ireland, but then fishing from Boston, had the schooner *Sylph* built on purpose for trying the experiment of fishing with a beam-trawl off the New England coast. Captain Leonard visited Ireland and brought back with him sufficient apparatus for making the experiment. The trawl was tried off Cape Cod, but with no success; therefore that method of fishing had to be abandoned.

"The captain and crew of the *Sylph*," says Captain Walen, "anticipating excellent results from this innovation in American fisheries, kept their proposed experiments a profound secret, hoping not only to profit by being first in the field in this new enterprise, but also fearing the antagonism of other fishermen not similarly provided."

Mr. J. H. McManus, of Boston, who was part owner of the *Sylph* at the time the experiment above referred to was tried, says she carried a beam-trawl of the largest size, having a 50-foot beam, that it was set five times off Cape Cod in 10 to 20 fathoms of water, but no fish of any consequence, except flounders, was taken in it. The crew of the *Sylph*, being all poor men, according to Mr. McManus, could not afford to continue the trials. Therefore the attempt to use this form of apparatus was given up, and the three trawls which had been brought over from Ireland were sold to parties in Virginia to use for some unknown purpose in Chesapeake Bay.

Mr. McManus thinks that possibly one cause of this failure to introduce the beam-trawl was due to the foot-line not being heavy enough for that purpose, but he is, nevertheless, of the opinion that it can not be used to good advantage north of Cape Cod.

Mr. A. Booth, of Chicago, well known throughout the United States as an extensive packer of fish and oysters, told me while at London, July, 1883, that he imported a beam-trawl from England as early as 1873. He tried to use it for the capture of whitefish (*Coregonus*) on Lake Michigan; but although a few were taken, the attempt was a failure, since the trawl could not be successfully used there, because it became frequently entangled with the sunken logs that were more or less numerous on the bottom of the lake. He also stated that he had no one experienced in this particular fishery to handle his trawl, and therefore he is not fully satisfied that it is impracticable to use this form of apparatus in some of the lake fisheries.

In the scientific investigations made by the U. S. Fish Commission off the Atlantic coast, from Cape Hatteras to Halifax, Nova Scotia, the beam-trawl has been extensively used, and among the various new species of fish that have been captured in it may be mentioned the pole flounder (*Glyptocephalus cynoglossus*), which was first taken on the New England coast in 1877. This species, which for food purposes is pronounced quite equal to the European sole, has a very small mouth, and can therefore be taken in large numbers only in a beam-trawl. It occurs in greater or less abundance off the New England coast, and northwardly to the Grand Bank.

Lieutenant-Commander Z. L. Tanner, who has for several years been in command of the Fish Commission's steamers, has used the beam-trawl very extensively for scientific purposes in the waters of Massachusetts Bay and off Cape Cod, as well as elsewhere along the coast. He says that there are large areas on the eastern slope of Stellwagen Bank and east of Cape Cod, outside of a depth of 45 fathoms, where a beam-trawl could be employed to advantage, the bottom being a mixture of sand

and mud. These localities are noted for an abundance of flat-fish, among which the pole flounder occurs in large numbers. He believes it would be entirely practicable to carry on beam-trawling in those waters, but thinks it would be necessary to have a steam capstan to get the gear up.

The peculiar form of trawl-net which is used in the Mediterranean is successfully worked in the waters off the west coast of the United States.

Prof. David S. Jordan, who investigated the Pacific coast fisheries in 1879-'80, writing of the Italian fishermen of San Francisco, Cal., says that in 1876 the "paranzella" was introduced in the fisheries of that port. The fishermen of other nationalities threatened to burn up these nets, and the boats used when the nets were employed. San Francisco is the only place in this country where this style of fishing has been introduced. There were two antagonistic companies who used these nets; they have now consolidated and divide the profits equally. Each company has three boats and employs twelve or thirteen men, one of whom is constantly engaged in selling fish in the market. The stock is owned chiefly by men not actually engaged in fishing. This is divided irregularly, one man owning a net, another a boat, etc. Out of the gross profits are paid, first, the entire expenses, including provisions of the men, wear of the boats and nets, etc. The remainder is divided into shares, one share to each boat, one to each actual fisherman, and one-half share to each net actually in use. In these two companies, there being six boats, two nets, and twenty-five men, the whole is divided into thirty-two shares. The captain sometimes received one and one-fourth shares.

IV.—*POSSIBILITIES OF SUCCESSFULLY USING THE BEAM-TRAWL IN THE SEA FISHERIES OF THE UNITED STATES.*

So far as the ocean fisheries of the United States are concerned, more especially on the Atlantic coast, there is little probability that the beam-trawl will be employed for some time to come, chiefly for the following reasons: First, many parts of the fishing grounds, now most commonly frequented, are not suitable for beam-trawling, being too rough, and in many localities the water is too deep;[1] second, our most valuable ground fish—cod, haddock, halibut, etc.—occur in such abundance that far greater catches can generally be obtained with lines or gill-nets than it would be possible to get in a beam-trawl, and as bait can usually be obtained at a moderate outlay, the lack of this is not an inducement, as it is in Europe, to adopt beam-trawling; third, the flat fishes—several species of flounders, dabs, etc.—that occur off the east coast of the United States, and for the capture of which the beam-trawl is more specially adapted, are now of comparatively little value in our markets, and half a ton of them would scarcely bring as much as is obtained in London for a hundred pounds of soles.

---

[1] Though it is true that large tracts of the best fishing grounds are too rough for beam-trawling, it nevertheless is a fact that there are extensive areas where trawls can be used, and should this form of apparatus ever be introduced into the fisheries of the United States, no doubt it will be found that grounds now little frequented may prove unexpected store-houses of wealth, so far as fish life is concerned.

The following statement of the arrivals of fishing vessels at Boston, Mass., in a single day, and the quantity of fresh haddock or cod on board of each, shows what enormous captures of these fish are sometimes made with trawl-lines. When it is understood that these fares of fish are often taken in a single day, and that a vessel seldom fishes longer than two or three days consecutively, it will be apparent enough that like results can not be obtained by using beam-trawls: "Schooner *Mabel Kennison*, Georges, 40,000 pounds haddock. Schooner *Emily P. Wright*, Georges, 40,000 pounds haddock. Schooner *Gertie E. Winsor*, La Have, 30,000 pounds haddock and cod. Schooner *Col. French*, Georges, 45,000 pounds haddock. Schooner *Hattie I. Phillips*, Georges, 75,000 pounds haddock. Schooner *Carrie and Annie*, Georges, 60,000 pounds haddock. Schooner *Rebecca Bartlett*, Georges, 45,000 pounds haddock. Schooner *Henry W. Longfellow*, Georges, 60,000 pounds haddock. Schooner *Eben Parsons*, Georges, 60,000 pounds haddock. Schooner *Dido*, Georges, 40,000 pounds haddock. Schooner *Mascott*, Georges, 50,000 pounds haddock. Schooner *A. R. Crittenden*, Georges, 35,000 pounds haddock. Schooner *Mystic*, Georges, 30,000 pounds haddock. Schooner *Charles P. Boynton*, Georges, 40,000 pounds. Schooner *Loring B. Haskell*, Georges, 60,000 pounds haddock. Schooner *Pendragon*, Georges, 30,000 pounds haddock. Schooner *Iolanthe*, Georges, 30,000 pounds haddock. Schooner *J. W. Campbell*, Georges, 45,000 pounds haddock. Schooner *J. A. Garland*, Georges, 60,000 pounds haddock. Schooner *Clytie*, Georges, 45,000 pounds haddock. Schooner *Rebecca Bartlett*, Georges, 50,000 pounds haddock. Schooner *Edward Trevoy*, Georges, 60,000 pounds haddock. Schooner *Matthew Kenny*, Georges, 50,000 pounds haddock. Schooner *Tidal Wave*, Georges, 50,000 pounds cod. Schooner *D. D. Winchester*, Georges, 60,000 pounds haddock. Schooner *Andrew Grimes*, Georges, 30,000 pounds haddock. Schooner *Fannie W. Freeman*, Georges, 60,000 pounds haddock. Schooner *Annie D.*, Georges, 50,000 pounds haddock. Schooner *Sarah C. Wharf*, Ipswich Bay, 35,000 pounds cod. Schooner *Grover Cleveland*, Georges, 25,000 pounds haddock. Schooner *Rapid Transit*, Georges, 50,000 pounds haddock. Schooner *Mary A. Clark*, Georges, 50,000 pounds haddock. Schooner *W. Parnell O'Hara*, Georges, 40,000 pounds haddock. Schooner *Carrier Dove*, Georges, 45,000 pounds haddock. Schooner *New England*, Georges, 45,000 pounds haddock. Schooner *Ethel Maud*, Georges, 45,000 pounds haddock. Schooner *Ellen Swift*, Georges, 45,000 pounds haddock. Schooner *Addie Winthrop*, Georges, 40,000 pounds haddock. Schooner *Chester R. Lawrence*, Georges, 50,000 pounds haddock. Schooner *Reporter*, Georges, 75,000 pounds haddock. Schooner *Phil. Sheridan*, Georges, 60,000 pounds haddock. Schooner

Gertie Evelyn, Georges, 48,000 pounds haddock. Schooner *Edith Emery*, Georges, 60,000 pounds haddock."[1]

It is therefore evident that, with such conditions prevailing, the beam-trawl can not be profitably employed off the Atlantic coast, even supposing extraordinary catches could be taken in it. However, should the demand for flat-fish increase in the future, which is extremely probable, it will doubtless be found that beam-trawling can be prosecuted off our eastern shores with profit and success, while, in a country having such a vast extent of sea-coast as the United States has, and such varied fisheries, it is impossible to say what may not be done with an apparatus which is so effective as is the beam-trawl for the capture of ground fish. The fact that the "paranzella" has been profitably employed on the Pacific coast is a matter of interest in this connection, and indicates that there may be, in that region, an opportunity to use the beam-trawl, which is a much more effective form of apparatus.

---

[1] Boston Daily Herald, February 12, 1886. The names "Georges" and "La Have" refer to Georges Bank and La Have Bank, where the fish were caught.

INDEX.

Page.

- Allen & Co., D, 294
- Alward & Eskritt, 326
- Ansell, Alfred W., quoted, 295, 296, 298, 300
- Apparatus of Belgian trawlers, 391
  - Dutch trawlers, 395
  - French trawlers, 389
  - German trawlers, 399
- Apprentice system, 304
- Ashcroft, R. L., quoted, 345
- Ashore or Afloat cited, 298
- Baird, Spencer F., 373
- Baitings of trawl-net, 317
- Balch-line of trawl-net, 319
- Barking beam-trawl fishery, 292
- Beam, description of, 311
- Beam-trawl, description of, 310
  - experiments with in the United States, 400, 401
  - fisheries of Belgium, 390
    - Europe, 388
    - France, 388
    - Germany, 398
    - Great Britain, 291
    - Holland, 393
    - Spain, 399
    - the United States, 400
  - fishery, growth of, 295
    - persons employed in, 296
    - statistics of, 296
    - value of, 296
  - fishing, effect of, 369, 370
    - on the Atlantic coast, 402
  - methods of handling, 345
  - used by the U. S. F. C., 401
- Beam-trawler, crew of, 300
- Beam-trawls introduced, 292, 394
- Belgian beam-trawl fishery, 390
- Belly of trawl-net, 322
- Billingsgate, fish landed at, 359
- Birmingham as a fish market, 366
- Bland, John, 358
- Boarding fish, 357
- Bomschuiten described, 394
- Booth, A, 401
- Boston as a fish market, 403
  - Daily Herald cited, 404
- Bou net described, 399
- British deep-sea trawlers, number of, 296
  - Fish Trade cited, 362
- Brixham beam-trawl fishery, 292
  - fish sale, 362
- Caller-Ou, steamer, trial trip of, 346
- Capstan, description of, 325

Page.

- Carr, T. F. Robertson, assistance by, 291
  - quoted, 294, 370
- Cattran, Edward, cited, 299
- Cod-end, 318, 320
  - hoisting of, 344
- Cod-line, 318
- Cod of trawl-net, 318
- Commerma, Captain, cited, 399, 400
- Cook, duties of, 301
- Crew, pay of, 367
- Cromer Knowl, description of, 299
- Cruise on a British North-Sea trawler, 373
- Dandy, 326
  - bridle chock, 328
  - wink, 327
- Day, Dr. Francis, quoted, 298
- De Caux, J. W., trawl improvements, 314, 324
- Deck hand, duties of, 302
- Deep-sea Fishing and Fishing Boats cited, 293, 310, 312, 319, 320, 340, 389, 390
- Diddle net, 331
- Doddle net, 331
- Dogger Bank, description of, 297
- Duchochois, A, 291
- Duff, R. W., cited, 360
- Dummy, description of, 327, 328
- Dunell, George R., quoted, 326, 352
- Edinburgh, Duke of, quoted, 296, 353, 356, 367, 368
- Engine for capstan, 326
- English trawling ports, list of, 294
- Fish auction, 360
  - boarding of, 354
  - boxes, 329, 382, 386
  - care of, 354
  - carriage, 359, 365
  - carriers, 351
  - classification of, 354
  - catch of, 385
  - depletion of, 369, 373
  - destruction of, 369
  - dressing of, 355
  - in market, size of, 372
  - kinds taken, 299
  - landing of, 359
  - marketing of, 359
  - packing of, 354, 355, 359
  - price of, 360, 371
  - quantity taken, 403
  - selling of, 360
  - tackle, 329
  - taken by trawl, 340, 344, 380
    - with trawl-lines, 403
  - Trades Gazette cited, 363, 368

Page.
Fish, transfer of 358
Fisheries of the World cited 360
Fisherman's Magazine cited 292
      Seamanship cited 299, 302, 303, 323, 334, 340
Fishermen 300
    courtesy of 387
    intelligence of 387
Fishermen's hardships 384
Fishery Board for Scotland, report cited 294
Fishing apparatus 310
  grounds 296
      list of 297, 372
      of Belgian trawlers 390
        Dutch trawlers 394
        French trawlers 388
        German trawlers 398
  methods of 332
        Belgian trawlers 393
        Dutch trawlers 397
        French trawlers 390
        German trawlers 399
Flapper of trawl-net 318, 323
Fleeting system, advantages of 353, 354
      establishment of 350
Foot of trawl-net 310
  rope, de Caux's 319
    of trawl-net 319
Frank Buckland, trawling vessel 326
French beam-trawl fishery 388
German beam-trawl fishery 398
Goode, G. Brown 373
Gorings of trawl-net 318
Granton, steamer 306
Great Fisher Bank, description of 298
    Silver-Pits, description of 298
Grimsby as a fish-market 366, 376
      fishing port 295, 375
    trawlers system of fishing 352
Groen, W., trawl-head of 395
Ground of trawl-net 322
    rope of trawl-net 320
Hawse, description of 336
Head-rope of trawl-net 319
Heaving up the trawl 342
Hellyer, Charles, quoted 368
Hewett & Co 350
History 291
Holdsworth, Edmund W. H., quoted 293, 294, 300, 307, 309, 311, 313, 329, 332, 333, 334, 341, 377, 389, 397
Holland, beam-trawl fishery of 393
Hull 295
  as a fish market 366
Ice-mill, description of 330
    used by fish packers 376
Introductory note 290
Jex, Edward, assistance by 291
      cited 295, 369, 371
Jordan, David S., cited 402
Le Lorrain, Jules, assistance by 291
        cited 390
Leonard, Richard 400
Liverpool as a fish market 366
Loading fish vans 377
Page.
London as a fish market 366
Lowestoft 295
Maas, A. E 397
McManus, J. H 401
Manchester as a fish market 366
Marketing the catch 359
Master, duties of 303
Mate, duties of 302
Mudd, Harrison, assistance by 291, 374
      quoted 295, 352
Nettle 335
Olsen, O. T., assistance by 291
      quoted 298, 299, 302, 323, 334, 335
Orange, Prince of 292
Otter trawl 316
Pad measure 329, 362
Parella described 399
    dimensions of 400
Plimsoll, Samuel, quoted 349, 366
Pockets of trawl-net 318
Poke-line of trawl-net 318
Pot measure 329, 330
Profits, method of dividing 367
Rockwell, Julius E 373
Sailing trawler 306
Sala, Mr., quoted 361
Scotsman cited 294, 346, 370
Scottish trawling ports, list of 294
Sea Fishing on the Southwest Coast cited 362
Seamen, duties of 301, 302
Shares, method of dividing 367, 368, 369
Shepherd, H. C. W 315
Shields fish market 363
Signal code for fleet fishing 349
Sims, Mr., quoted 315, 341, 367
Single-boating system 348, 393, 397, 399
        advantages of 354
Sizes of meshes in trawl-nets 320
Sobriety, cutter 313
Spanish beam-trawl fishery 399
Square of trawl-net 317
Staying the trawl around 339
Steam capstans 325
  trawlers, earnings of 368
Sylph, schooner 400
Tacking with the trawl out 338
Tanner, Z. L 401
Tidal influence on trawling 332
Tidder, Capt. Henry 378
Trawl, apparatus for operating 324
  capsizing of 384
  dimensions of 322
  fishery, earliest notice of 291
      vessels employed in 371
  hauling the 386
  improvements, de Caux's 324
  manner of heaving up 342, 380
  righting of 335
  shooting of 334, 335, 379, 381
      around the stern 337
      from the port side 333
      from starboard side 337
  stayed around 339
  wearing around 338, 385
  working of 340

Page.
Trawl-bridles, description of ... 321
Trawl-head, Barking pattern ... 313, 392
Belgian ... 391, 392
de Caux's ... 314
description of ... 312
dimensions of ... 315
Dutch ... 396
for inshore ... 314
Groen's ... 395
used inshore ... 392
weight of ... 313
with Shepherd's device ... 315
Trawl-net, description of ... 316, 317, 318
directions for putting together ... 323
early history of ... 293
size of meshes in ... 320
Trawl-rope stopper ... 335
Trawl-warp, description of ... 321
roller ... 327, 328
Trawler cruise, diary of ... 378
on ... 373, 388
Trawler's boat ... 331
Trawling in "the rough" ... 383
methods of ... 348
steamers ... 306
vessels, cost of ... 310
description of ... 309
dimensions of ... 306, 307

Page.
Trawling vessels, earnings of ... 367
model of ... 308
rig of ... 307, 309
Trunk measure ... 330
Vessel caught with a weather tide ... 340
dropped around with trawl out ... 339
management of, with trawl out ... 338
prevented from catching around ... 340
Vessels, earnings of ... 367
of Belgian trawlers ... 390
Dutch trawlers ... 394
French trawlers ... 389
German trawlers ... 398
types of ... 305
Visiting a trawler ... 387
Walen, Sylvester ... 400
Walker, David, cited ... 294
Walpole, Spencer, assistance by ... 373
quoted ... 362, 366
Wearing the trawl around ... 338
Wilcocks, J. C., quoted ... 311, 362
Willie and Ada, smack ... 306, 313, 342, 374
Winch, description of ... 326
forward ... 327
Wings of trawl-net ... 318, 322
Yarmouth trawling vessels ... 309
Zodiac, steamer ... 306

61.—REPORT UPON THE RESULTS OF SALMON PLANTING IN THE HUDSON RIVER.

By FRED MATHER.

In compliance with instructions from the U. S. Commissioner of Fish and Fisheries, dated July 11, 1888, I made, during the summer and fall of 1888, an examination of the Hudson River from its mouth to the tributary trout streams of Warren County, N. Y., with a view of ascertaining the number of adult fish captured during the last season, and the possibilities of taking salmon eggs in sufficient numbers to warrant the establishment of a temporary station for this purpose; with the object of learning the character of the small streams, and determining which give promise of the best conditions for developing the young fish during their river life; and also for the purpose of obtaining information respecting the height and character of the natural and artificial obstructions to the ascent of salmon. The results of these investigations are herewith presented.

PLANTINGS OF SALMON.

With the exception of some quinnat, or chinook, salmon planted in the Hudson ten or a dozen years ago by the New York Fishery Commission, which have never been heard from, I believe that all the plantings of *Salmo salar* in the river have been made under my immediate supervision.

In 1880 I suggested to the late Prof. Spencer F. Baird, then U. S. Commissioner of Fisheries, that the streams of the upper Hudson had all the requisites for growing young salmon, and he agreed with me that it might be possible that the river had never been a salmon river because of the natural obstructions to the ascent of the parent fish. On January 16, 1882, I was ordered to try to obtain a hatchery near New York City for the purpose of hatching salmon for the Hudson, and secured one from Mr. Thomas Clapham, at Roslyn, on the north side of Long Island, about 23 miles from the city, and in the spring planted 225,000 fry in the streams of Warren County, as well as some in other waters.*

In January, 1883, I was appointed superintendent of the new hatching station of the New York Fishery Commission at Cold Spring Harbor, Long Island, and transferred the work of salmon hatching there, where it has since been conducted.

---

* Rept. U. S. Fish Commission, 1882, p. 876.

The following plants have been made in the tributaries of the river:

1882	225,000
1883	244,900
1884	385,700
1885	*319,100
1886	297,573
1887	140,450
1888	440,000
Total	*2,052,723

Where the odd figures occur I would explain that there was no pretense to actual count, but from the measured number of eggs there was an actual count of the losses of eggs and fry, my men being instructed to keep such a record, and the loss being deducted left odd numbers, which were always added in the last shipment, except in cases of loss in transportation, when they were deducted from that particular shipment.

The streams in which the fry were placed are good trout streams, but there exists great confusion as to their names; for instance, while on this investigation, I asked Nat. Bennett, a well-known Adirondack guide, where "Roaring Brook" was, and he said that it was only another name for "Thirteenth Brook." This happened at the North River Hotel, and the latter brook empties into the Hudson about 100 yards above, while others said that "Roaring Brook" was a tributary of North Creek. As it will be found that a brook by this name was stocked in four different years, I can not say which one received the two plantings of 1883, made by O. B. Hewitt; nor that in 1884, by F. A. Walters, because the men are no longer in my employ, and I do not know their addresses. The plantings in "Roaring Brook," made in 1886 by C. H. Walters, and in 1888 by O. V. Rogers, were in the stream emptying into North Creek. Depending, as we must, on the natives for the nomenclature of these little mountain streams, we find that the names are much mixed, and the maps do not name these little brooks. My foreman, C. H. Walters, tells me that Eldridge Brook, stocked by him in 1886, is the stream also known as "Balm of Gilead," and that it had two plantings in that year in consequence of its double name. I have now a better knowledge of the smaller brooks, and will try to avoid confusion of this kind in the future. The following is a list of the brooks, with the numbers of salmon placed in them:

Carr's Brook, also called "Deleby Brook," which comes into the Hudson from the east, a mile or two above North Creek, the northern terminus of the Adirondack Railroad, is a good trout stream, and is one of the best for planting salmon, as it contains insect larvæ and crustaceans in apparent plenty. It received the following plants:

---

* And 150 yearlings.

1882	35,000
1883	49,800
1884	39,200
1886	119,600
1887	49,000
1888	50,000
Total	342,600

Glen Brook flows in from the west at the station of the Adirondack Railroad called The Glen, and is some 20 or 30 miles below North Creek. It received 50,000 in 1882 and 39,000 in 1884. It is said to be a good trout brook.

Balm of Gilead Brook, also known as "Eldridge Brook," is a fine stream which comes into the river from the west, half a mile below the village of North River, and received the following plants:

1882	40,000
1883	49,700
1884	39,000
1886	*58,973
1886	*59,800
1887	49,700
1888	50,000
Total	347,173

Raymond Brook.—This is a good stream, which comes in from the west, 2 or 3 miles above North Creek and below Balm of Gilead; it appears in the earlier reports as "Raymont." It had:

1882	45,000
1883	39,000
1884	38,000
1885	49,800
1886	49,500
1888	50,000
Total	271,300

Roblee Brook.—This is not a good stream, because the lower portion is dry in summer. It runs through the village of North Creek and is a strong stream most of the year. In 1888 it had 50,000 fry, but I would not recommend it for future stocking. There is another brook by this name which comes into North Creek.

North Creek.—This is a good stream. It has a dam and a tannery at its mouth, in the village of the same name. It directly received:

1884	38,900
1887	41,750
1888	55,000
Total	135,650

---

*These two plants were made in the same brook, owing to the confusion of names by the residents in recommending it.

Besides this it had plants in one of its tributaries, known as Roaring Brook, given below.

Roaring Brook.—This stream is referred to on page 410, and I have reason to believe that all the plants made were in the tributary of North Creek, and not in Thirteenth Brook. Those of 1886 and of 1888 certainly were. The stream received:

1883	*67,400
1884	38,800
1886	59,800
1888	50,000
Total	216,000

Thirteenth Brook.—A rapid stream, which comes from the west and empties at the village of North River. It is sometimes dammed for logging purposes, but was avoided on the years when it was so used. It received:

1885	†79,900
1888	50,000
Total	129,900

Beaver Meadow Brook is a tributary of Indian River, which enters the Hudson in Essex County. The brook crosses the stage road from North River to Blue Mountain Lake, about 8 miles from the former place, and if the roads were better in the spring this would be a good point of deposit. In 1883 there were 39,000 salmon planted in this stream.

Indian River received 36,200 in 1884.

Minerva Brook was stocked in 1888 with 35,000 salmon at Olmsteadville, Essex County. It is a tributary of the Schroon River, which enters the Hudson at Warrensburgh, some 20 miles, as the crow flies, below, but by the course of the river is nearly double that distance. This stream is a celebrated trout brook, and I strongly recommend it for salmon.

Loon Lake empties into the Schroon at Starbuckville, Warren County, and received 38,600 salmon in 1884. I am not certain that lake plantings are good for these fish. I prefer mountain brooks.

Gulf Brook and Hokum Pond received 55,000 fry in 1882. Hokum Pond is in the town of Johnsburgh, Warren County, south and west of the village of North Creek. Its outlet is Mill Brook (not Mill Creek, in same county), which is tributary to North Creek. Gulf Brook empties into Mill Brook near the outlet of Hokum Pond.

Kelso Brook was stocked with 37,000 in 1884. It empties into Minerva Brook a mile above Olmsteadville, in Essex County, and is therefore tributary to the Schroon River. Another stream with the same name empties into Carr's Brook in the town of Chester, Warren County.

Cedar River comes from the southwest and joins the Hudson in Essex County, about 3 miles above the point where Indian River comes in.

---

* Two plants.

† In the reports this plant was credited to North River.

It rises in the Cedar Lakes, near the middle of Hamilton County, and flows northeast. Within a mile or two of its source, the West Canada Creek rises and flows off southwest to the Mohawk, and the south branch of Moose River, another tributary of the Mohawk, via Black River, rises within a mile and a half of the Cedar. In 1885 I made a plant of 59,900 salmon in the Cedar, where the stage road from North River to Blue Mountain Lake crosses it, just beyond the village of Indian Lake. There was no logging on the stream that year, and the fish could have a run of a dozen or more miles up the river.

Clendon Brook flows into the Hudson about 5 miles above Glens Falls and is an excellent stream for salmon. I have already recommended this stream, and at a meeting of the American Fisheries Society, in Washington, have shown young salmon from it which were caught and sent by Mr. A. N. Cheney, who, I think, also sent some to Mr. E. G. Blackford. It is a good trout stream, and is protected by its owners against public fishing. On the 23d of August, 1888, in company with Mr. Cheney, I visited the brook and we fished it for about half a mile. In an open spot we took a few chubs and a few little trout, which we returned to the water. Following down the stream, through a dense growth of alders, we found a pool in which was a school of perhaps twenty fish, which Mr. Cheney said were salmon, and on casting his fly in it he took one, which proved to be a salmon of 7 inches in length. In another pool he took a second one, and by letting my fly drift down under the brush, leaving the rod back on the ground and holding the line in my hand, I brought one up where I could identify it before it broke loose. Mr. Cheney's fish were both returned to the stream. We then stopped. I had seen enough to assure me that the fish were there in numbers.

Clendon Brook has received the following plants:

1884	41,000
1885	*59,700
1886	19,700
1888	50,000
Total	*170,400

I can strongly recommend this brook for future plantings. It not only is a good stream for rearing the fry in, but is below several of the falls, especially the great one at Jessup's Landing, which is a formidable one for a fish to go over, but which is dry in summer, owing to the water being used in the great paper mill at that place. (See account of Palmer's Falls, under the head of "Dams and obstructions.")

When I began the work, Professor Baird left the selection of streams to me, as I had a slight knowledge of the Adirondack region, but some of the brooks I did not know and depended on the opinions of the natives, judging that if they were good trout brooks they would do for salmon. I am, however, more indebted to Mr. Cheney than to any other man for this information, as well as that respecting the dams and obstructions lower down, as he has fished that country very extensively, and is one of our best-informed anglers. Stoddard's excellent map of the Adirondacks was also of use, but its scale does not permit the naming of the smaller brooks.

---

* And 150 yearlings.

Recapitulation of plantings since 1882.

Carr's Brook	342,600
Balm of Gilead Brook	347,173
The Glen Brook	89,000
North Creek Brook	135,650
Raymond Brook	271,300
Gulf Brook	55,000
Roblee Brook	50,000
Minerva Brook (including Kelso)	72,000
Beaver Meadow Brook	39,000
Roaring Brook	216,000
Clendon Brook	*170,400
Thirteenth Brook	129,900
Indian River	36,200
Cedar River	59,900
Loon Lake	38,600
Total	2,052,723

CAPTURES OF SALMON.

Up to 1888 it may be fair to consider only the three first plantings, which comprised 890,000 fry. In 1886 several salmon were taken, one by John B. Denyse, in Gravesend Bay, and three at the Troy dam, the weights ranging from 10 to 14½ pounds.† It has been estimated that a dozen or more were taken in that year by the fishermen. Mr. Blackford bought the salmon caught by Denyse, and displayed it on his stand, where it attracted great attention as a Hudson River salmon.

In 1887 many "North River salmon" were sold in New York, and were reported to have been taken up the river, although I know that some were taken in Gravesend Bay. On November 1 of that year a spent male salmon was taken at Port Monmouth, N. J., and sent to Mr. Blackford. It was very poor, and while it measured 2½ feet in length it weighed but 7 pounds. The hook on the jaw was slight, and the sides were blotched with red, as is usual with a ripe or spent male.

This year, 1888, I have met with some difficulty in interviewing the shad fishermen, who are the ones who catch them, because of a New York State law, enacted during 1887, which forbids their capture, except with hook and line. The law is as follows:

CHAP. 530, LAWS OF NEW YORK.

AN ACT for the protection and preservation of salmon in the waters of this State.

Passed June 6, 1887, three-fifths being present.

The people of the State of New York, represented in senate and assembly, do enact as follows:

SECTION 1. No person shall at any time kill or catch, or attempt to kill or catch, salmon in the waters of this State with any device, or in any manner, save that of angling with line or rod held in hand.

SEC. 2. No person shall catch, or attempt to catch or kill, any salmon in said waters save only from the first of March to the fifteenth day of August in each year.

---

* And 150 yearlings.

† Rept. U. S. Fish Commission for 1885, foot-note to page 110.

SEC. 3. Any person using nets in that part of the Hudson River within the jurisdiction of this State, in fishing for other fish allowed to be taken therein by nets, shall upon catching any salmon immediately return and restore the same to the water, without injury. The foregoing provisions are not to apply to the operations of State or public hatcheries or to the artificial propagation of said fish by State or public authority.

SEC. 4. Any person violating any of the foregoing provisions of this act shall be deemed guilty of a misdemeanor, and, in addition, shall be liable to a penalty of one hundred dollars or one day's imprisonment for each dollar of fine; any informer to receive one-half of said fine. Actions for any violation of this act may be brought before any justice of the peace in any county which borders on the river or water opposite where the offense was committed, without regard to channel boundaries.

SEC. 5. All acts inconsistent with this act are hereby repealed.

SEC. 6. This act shall take effect immediately.

Being assured that the information was desired for the use of the U. S. Fish Commission, in order to judge of the expediency of continuing the planting of salmon fry in the Hudson River, many records of captures were obtained, and they are all supposed to be authentic. The names of the fishermen who took them incidentally in their shad nets, in New York waters, are omitted.

Gravesend Bay.—The largest number of salmon taken by one man, which has come to my knowledge, is ten. These were captured in fyke nets set for shad in Gravesend Bay, which is a part of Lower New York Bay, between May 9 and 29. They averaged from 9 to 12 pounds each, the largest weighing 19 pounds. Eighteen more fish were taken in the same bay, making twenty-eight in all. Seven were caught by one person, four by another, three by a third, while four men took one fish each.

New York Bay.—There were twenty fish taken in the bay, weights not given. The following men took them: L. Kells, Greenville, N. J., 3; H. Meserole, ditto, 4; J. Gelshion, ditto, 4; J. M. Minugh, Communipaw, N. J., 2; J. Woods, ditto, 1; J. McLaughlin, Jersey City, N. J., 1; George Griffin, Pamrapo, N. J., 2; Van Buskirk & Titus, ditto, 2; Richard Cadmus, Bayonne, N. J., 1; total, 20.

Prince's Bay.—Three fish are recorded from this water: D. Finnegan, Morris & Brown, and W. M. Morris, all of Port Monmouth, N. J., each took one.

New Jersey shore of the Hudson.—Five salmon were taken just above Weehawken by as many men or fishing partners, J. & J. Ludlow, S. & J. Ludlow, and R. Du Bois, all of Weehawken; each took one salmon, as did also Henry Scott, of Pleasant Valley, N. J., and Barber & Wilson, of Alpine, N. J.

From New York to Troy.—By favor of Mr. E. G. Blackford I obtained the addresses of the men who fish for shad in the Hudson, and was thereby enabled to go directly to the fishermen, which greatly simplified the work in the different cities and villages by saving the time in making inquiries for them. Mr. Henry Burden, also one of the New York fishery commissioners, helped me to many facts concerning the catch about and above Troy. Mr. Burden has taken much interest in this matter, and was instrumental in getting a McDonald fishway put in the Troy dam by the State mainly for the passage of salmon, which had been seen jumping at the dam and had been netted below it in former years. Mr. Matthew Kennedy, of the city of Hudson, and one of the fish and game protectors of the State, as well as a shad fisherman owning several nets and employing a number of men in season, gave me valuable assistance in reporting such salmon captures as had come to his knowledge.

Matthew Kennedy says that eight salmon were taken at Hudson by two parties, and the fish were returned to the water alive. He saw the fish, and his men caught some of them. His nets were old and tender and the salmon made holes in them, but if the nets had been stronger a great many more would have been taken. If the striped bass were as plenty about Hudson as they were a dozen years ago that fish would have been credited with making the holes, but the bass are scarce now, and he believes that salmon made them, for they were two small to have been made by sturgeon. Four of these fish were taken on one day in rough weather, and Mr. Kennedy thinks it worthy of note that all the others were taken when the water was rough. They were caught between the 1st and 14th of June. The water in the river was very high up to the middle of May and but little shad fishing was done until after that date.

Stockport.—At Stockport four fish were taken, the weights of the same not being reported, and at New Baltimore three fish weighing 40 pounds, or an average of over 13 pounds each. At this point the channel is shallow and the nets are short, and salmon can escape them better than in most places.

At the following places I learned of fish being taken. The towns are given as found on my note-book, without regard to their geographical sequence. In some cases it was not possible to learn the names of the captors, nor the weights of the fish. Highland Falls, one; Mull's Fishery, seine, two, 11, 11½ pounds; Catskill Point, seine, one, 15 pounds; Cornwall, one, 9 pounds; Barrytown, drift net, two, 10¾, 13 pounds (several persons intimated that more were taken at this place but were cautious about giving information for fear of being called on as witnesses); Kingston Point, drift net, two, 10, 8 pounds; North Staatsburgh, two, 10, 12 pounds; Hyde Park, drift net, one; Elmore's Dock, drift net, two, 10, 18 pounds; Newburgh, one; Verplank's (Stony Point), three, 12¾, 11½, 15½ pounds.

Troy.—As before stated, Mr. Henry Burden kindly volunteered to get the needed information at this place, and his knowledge of men and locality enabled him to work the field better than a stranger could. I went out with him to a fisherman's floating house one day and found that the man in charge was very suspicious, and if he or his friends had caught any salmon they were not going to expose themselves to a fine by telling it. Mr. Burden writes me as follows:

224 THIRD STREET, TROY, *July* 30, 1888.

MR. FRED MATHER:

DEAR SIR: The catch of salmon in the vicinity of the Troy dam for the season of 1888 was twenty-six, varying in weight from 5 to 26 pounds. This number was known to have been taken, but the person who obtained the information thinks that more were caught.

Very truly,

HENRY BURDEN.

Of the salmon in the lower river, Forest and Stream of May 17, 1888, said:

Up to Saturday last fourteen salmon have been taken in the Hudson River between Communipaw and Yonkers. The largest one weighed 10¼ pounds and the smallest 8 pounds. They were taken by the shad fishermen in gill nets, and were therefore too badly injured to be returned to the water, as the law requires. The fisherman who took the fish at Yonkers did not know what it was, and on cutting it open found that it was red inside and threw it away as uneatable. The stocking of the river, begun by Professor Baird, is being continued by Colonel McDonald, and about 440,000 will be planted this spring from the Cold Spring Harbor hatchery. Over half of the fry have already been planted in the trout streams of Warren County, and the end of this week will find them all in the tributaries of the upper river. The experiment seems to be proving successful in spite of the doubters.

The Troy Times of May 26 said:

This morning W. E. Hagan, of the Fish and Game Protective Association, reported to District Attorney Griffith that a salmon had been caught at the State dam in a net. The catch of salmon in this way is a violation of chapter 530, Laws of 1887. The penalty is $100 fine or thirty day's imprisonment, at the option of the magistrate. A fine of $25 is also to be imposed on any person having in his possession a salmon caught in a net. The salmon was in the possession of McGrath & Laflam, fish dealers at the Fulton Market, Troy. They said they purchased the fish from William Askins, who caught it. The fish had been sold to a citizen, but when the latter was told that it would be a violation of law to receive it he declined to accept the salmon. District Attorney Griffith sent Officer Forest after Askins, who said he did not know that he had violated any law. He was admonished to refrain from fishing for salmon with a net hereafter, and as this was the first case reported, it is not probable that Askins will be prosecuted. The same law prohibits fishing in the Hudson River on Sunday, and the agents of the Fish and Game Protective Association called on Superintendent Willard and requested that the law be enforced within the city limits. The superintendent said he would direct the police to enforce the law. The salmon caught at the dam weighs 20 pounds.

Mechanicsville.—Some fish went over the Troy dam in the June rise and got up as far as Mechanicsville, where the dam is high and impassable even at the greatest floods known. Concerning this I have received the following letter:

GLENS FALLS, N. Y., *July* 24, 1888.

MR. FRED MATHER:

DEAR SIR: Mr. A. C. Johnson, of Mechanicsville, N. Y., writes me that the salmon are below the dam at that place. He saw five at one time yesterday, and one was found dead last week, which weighed 12¼ pounds. He says that the boys want to shoot or spear them, but he does not mean that they shall. The water is low, and the fish can not pass the dam. He says they are all big fish. There is a necessity for fishways in order to let the fish get to the breeding grounds, and the dam should be watched in order to keep the fish from being destroyed. The people should be instructed to let the breeding fish alone in order that they may be benefitted hereafter.

A. N. CHENEY.

There was a rumor that several salmon had been dynamited at Mechanicsville, and the following letters relate to this:

TROY CLUB, *August* 18, 1888.

Mr. FRED MATHER:

DEAR SIR: On my return home from Rochester I found a letter from Mr. A. N. Cheney giving an account of the dynamite outrage at Mechanicsville, and stating that he had written the Lake George game constable to go over there and investigate. I visited Mechanicsville a few days ago, with the builder of the Troy fishway, to look at the dam at that place. I saw Mr. A. C. Johnson, the person who reported about the dynamite to Mr. Cheney, and he said that no game constable had been there and that it was now too late to fasten the crime on any one from the evidence on hand, although suspicion pointed strongly to two prominent citizens of the village. He said that three salmon, weighing from 8¼ to 12¼ pounds, were found dead floating about the day after the dynamite was used.

Mr. Johnson also reported that a salmon was taken there recently on a trolling-spoon. I never heard of such a case, and can hardly believe it. Will investigate further and try and find out about it.

HENRY BURDEN.

TROY, N. Y., *November* 12, 1888.

Mr. FRED MATHER:

The name of the man who took a salmon with a trolling-spoon is John Conners. He is employed in the Fitchburg car-shops at Mechanicsville.

HENRY BURDEN.

Newburgh Bay.—A newspaper slip, sent me by a correspondent, said that Mr. Eugene B. O'Sullivan, who lives at Fishkill Landing, caught a salmon weighing 9¾ pounds with a fly, and sold it to Thomas Talbot, a fish dealer at the latter place. This was important if true, and in conversation with State Game Protector Willett Kidd, I told him of it. Mr. Kidd kindly looked the matter up, and found that the fish was taken in a shad net.

Recapitulation of captures.

Gravesend Bay	28	Kingston Point	2
New York Bay	20	North Staatsburgh	2
Prince's Bay	3	Hyde Park	1
New Jersey shore	5	Elmore's Dock	2
Hudson City	8	Newburgh	1
Stockport	4	Newburgh Bay	1
New Baltimore	3	Verplank's	3
Highland Falls	1	Communipaw to Yonkers	14
Mulls' Fishery	2	Troy, below the dam	26
Catskill Point	1	Mechanicsville	4
Cornwall	1		
Barrytown	2	Total known	134

I have no doubt that four times this number were taken by the shad fishermen, who, as before stated, are very cautious about giving information.

PROSPECTS FOR SPAWN GATHERING.

There are but two places where the fish have been taken in sufficient numbers to enable us to get some spawning fish. These are Troy and Gravesend Bay. At Troy a number could be caught or bought from the shad fishermen. At Gravesend Bay they might be kept alive by the fishermen until the season was over, and then be purchased. The fishermen at this place did not know of any law on the subject, and openly sold their fish in the New York markets, receiving from 25 cents to $1 per pound, the last figure being for the first two or three fish taken.

I do not think the water in the Hudson below Troy is cool enough to pen salmon. Between Troy and Mechanicsville there are deep, cool spots which I think would answer. Mr. Burden thinks that the trout ponds at Cold Spring Harbor would be the best place to keep those captured in the lower river until the spawning season, and in this I agree with him. At Mechanicsville the fish would require watching night and day, but this might be done by watchmen at the mills, or an inclosure might be made in the tail-races of the mills where it would be difficult of access. I believe that some eggs might be taken next season, but experiment only would determine the number and the cost of obtaining them. If the operations were confined to the upper river a few might be obtained at Hudson, through Matthew Kennedy, and taken up in a fish-car to add to the Troy catch. If the lower river was to be worked for fish to store at Cold Spring Harbor, a small sail-boat with a well in it would be needed.

POLLUTIONS OF THE RIVER.

In my opinion ordinary house or water-closet sewage does no harm to fish in a big river. In proof of this, I would call attention to the fact that shad have increased in the Hudson, through artificial culture, in spite of the growth of cities along its banks. Chemical works pollute the water to some extent, but the injury depends entirely on the relative amounts of chemicals and water. A poisonous stream entering one side of a river does not mix at once with the whole stream, but continues down one shore, and is finally precipitated and becomes harmless. The poisoned water would kill a fish entering it, but the instinct of the fish teaches it to avoid it. At times the muddy water of the Missouri River can be seen for many miles below its junction with the Mississippi, and this will serve to illustrate this point.

The paper-mills formerly poured great quantities of chloride of lime in the river, and this substance was claimed, rightfully or otherwise, to be the cause of the decrease of shad in the Connecticut River some years ago, because of the paper-mills at South Hadley Falls, Mass.

There are paper-mills on the Hudson from Troy up to Jessup's Landing, both numerous and large, but in all of them that I visited I was told that the use of chloride of lime had decreased to a mere fraction of what was formerly employed. In these mills wood-pulp is the basis of paper, and it does not require the bleaching that other materials do, and, as one manufacturer said, "We do not use as much chloride of lime in a month as we did in a day before we began using wood-pulp, and you will find that this is the rule with all the paper-mills." In conversation with other paper manufacturers they confirmed this statement, and therefore there is now less than 4 per cent. of poison from the paper-mills than there was before wood-pulp was used to make paper.

DAMS AND OBSTRUCTIONS.

The first obstruction that a salmon meets in the Hudson is the State dam at Troy, which barred their ascent until in June last, when a rise in the river gave 2 feet of water on the crest of the dam, and some salmon went over it. These are the fish referred to above, seen at Mechanicsville. The State legislature made an appropriation for a fishway in this dam, and one was built last summer after the salmon run was over, by the McDonald Fishway Company. After the completion of this fishway I was in Troy, but the water was too high to see the structure, which, I am informed, is substantially built, and is complete in all respects. This form of fishway differs in principle from all others, and from a study of fishways in Europe and America I believe it to be the best in use. I have drawings of all the different fish passes in the world, some of which have never been published, and some of them are very odd. When in charge of the department of American fish-culture at the International Fisheries Exhibition, held at Berlin in 1880, I gathered a mass of material, which was never published because the Government did not issue a report of that exhibition, and among my sketches are some odd fishways in the English department. Allowing me to judge, I will say they were, some of them, of a most primitive sort, and of little use to most fishes. I merely cite this to show that I have paid attention to the construction of fishways, and have a knowledge of the principles of all the different fishways, without professing to know anything about the practical building of one. From a study of working models I am satisfied that the McDonald fishway is the easiest of ascent of any. I have seen a model of a catamaran actually go up one by the force of the side currents, while the water in the middle of the fishway was a turbulent rapid, gradually working down, but checked at every foot into a semblance of a mountain torrent.

I think, and so said in print a dozen years ago that fish will find the entrance to a fishway with greater certainty if it is at the foot of the dam, instead of below it, and would therefore advocate the building of a fishway above the dam, if possible to do so.

Mechanicsville.—The dam at this place is 9 miles above the Troy dam, and the water between them is a splendid series of salmon pools and rapids. It was at the foot of this dam that several salmon were seen jumping by a Mr. Greene, residing there, and where a 12-pound salmon (not elsewhere reported) was found dead by George Baxter. The bed of the river here, as well as above and below, is a slate formation. The dam is 15 feet high, built of stone laid in cement. I looked the dam over, in company with Commissioner Henry Burden, and settled on a place where a fishway could be placed. Later Mr. Burden visited the dam and wrote me as follows:

TROY, N. Y., *August* 18, 1888.

MR. FRED MATHER:

DEAR SIR: We found a new place to locate a fishway in the Mechanicsville dam, and that is alongside of the stone wall forming the canal from which the mill-wheels take water. The gates at the head of this canal are always open, so that fish could get through to the river above. If there is no pollution in this canal I think a fishway could be built as cheap, if not cheaper, than the one at Troy. It would be out of the way of ice, and would not cut into the main dam.

Sincerely yours,

HENRY BURDEN.

Stillwater.—This place has a dam made of logs, with an 8-foot perpendicular face, and it is 3 miles above Mechanicsville and 15 miles below the Fort Miller dam. Although the dam is 8 feet high on the west side of the river, it is not a foot high on the east side, and before the dam at Mechanicsville was built suckers and river herring (alewives) went over it in the spring. No fishway is needed here, because in ordinary seasons, while fish are running, they can pass this dam. Surely a salmon will have no trouble with an obstruction which a sucker can pass. A fishway at Mechanicsville would give the salmon a clean run from Troy to the next dam, a distance of 27 miles.

Thompson's Mills (P. O.).—The Saratoga State dam is at this place, 2 miles below the Fort Miller dam, and it is of stone, 824 feet long, 9½ feet high, with an apron of 10 feet. There are no falls here, only "riffs," or swift water, below. In stages of high water there is moderately deep water below, which would serve as a resting place for salmon.

Fort Miller.—The dam here is a wing-dam, 10 feet high at one end but only 18 inches at the other. It is of wood, with a square face, and would not obstruct the passage of salmon. It is 2 miles above Thompson's Mill.

Fort Edward.—There is an old wooden dam here, made of log cribs, which will soon require to be rebuilt, as it is much decayed. The dam is 16 feet high. There are good pools just below it, which have 14 feet of water in them at low water. There is a "spill-way" in the dam, through which all the water goes when the river is low. This is for the passage of logs in summer. Below the dam is a great bed of sawdust, on the east bank.

Baker's Falls and Dam.—These falls are at Sandy Hill, a few miles below Glens Falls. It is said that before there were any dams on the river the shad came up as far as this, but could go no farther. I heard this tradition from several persons, but can not say more. The falls are slate-rock and fall 58½ feet in about 500 to 600 feet, the exact height having been obtained from Allen Brothers, paper manufacturers. A pool below, where the shad formerly stopped, is said to be 70 feet deep. Half way up the falls is a pool about 125 by 75 feet, and apparently 15 feet deep. The dam on top of the fall varies from 3 to 8 feet in height. Above this dam, within half a mile, is Richard's dam, the intervening water being broken, falls perhaps 9 or 10 feet in that distance. This second dam is 11½ feet high, is new and made of hewed logs, with a spill-way at the deepest part of the river.

Glens Falls and Dam.—The falls are hard stratified rock, and at low water the descent from the crest of the dam is 40 feet, in a distance of 150 feet. There are several steps and pools; in some of them the vertical distance is not over 30 feet. In the center it is higher and consequently the great body of water flows to each side. I saw it on August 23, and the river was then exceptionally low. It looked at that time to be practicable to make a passage for fish part of the way in the rock.

State Dam, at Feeder Dam.—This is 1¾ miles above Glens Falls. It feeds the Champlain Canal and runs two saw-mills. Its height is 13 feet and 10 inches, and it is built of wood with an 18-foot apron. Water goes over this dam until July, when the brackets are put on and the water is all used by the canal and the mills. From this dam to Clendon Brook, above, is 5 miles by river.

Palmer's Falls.—These are at Jessup's Landing. The dam on the crest is 25 feet high, then rapids for a distance of 100 feet, more or less, and a sloping fall of about 50 or 60 feet. It is 85 feet from the pool below to the foot of the dam. In dry times the enormous paper-mill takes all the water in the river, but when I saw this fall, November 22, it was a terrible place to think of going over, either for a salmon or a man. While building the dam in this wild mountain gorge two men went over the falls. One was killed and the other was so badly injured that he has never fully recovered. If the salmon planted above this fall go down safely they can go the rest of the way without injury. I confess to being doubtful about it and begin to think that possibly Clendon Brook may have supplied a good share of the fish that have grown to maturity, for this fall surprised me with its violent rush through a narrow pass and its lack of a deep pool to receive the falling waters. I do not see how a living thing could escape being battered to death on the many exposed rocks, and especially at the foot of the dam, where there is a sheer fall of 25 feet and a shallow pool.

Rockwell's Falls.—These are at Luzerne, or Hadley. The village is on both sides of the river, in different counties, and has two names. This is the last obstruction on the river. The dam is 15 feet high on the west bank, and runs to nothing on the east bank. A salmon could go over it with ease, if it could get here. The Sacandaga River enters the Hudson about 200 yards below these falls.

CONCLUSION.

While I have expressed surprise that anything could live after passing Palmer's Falls I do not wish to be understood as saying that it is impossible for it to do so. The varying current, which would dash a man to pieces on the rocks, may be safely run by a salmon going down tail first and keeping steerage way all the time by a vigorous up-stream motion, but if one simply looks at these formidable falls with the idea that a salmon would go down them as he or any other mammal would, he would shudder at the thought. The fact that all fishes go down stream, in rapid water, tail first, when not hooked or frightened, must save them many a contusion, which a cow would get. I have seen a trout go over a small dam, when, of course, it did not know what might be below, and it would back down until its fear would cause it to resist the rapid current, and so would feel of it, always heading up-stream, until at last it let the water have its way, in part, only, and with head up-stream and caudal fin in active motion, it was prepared to meet the wild rush of water with such muscular energy as it could muster. Taking this view of the case it is possible that young salmon may safely go down any impediment in the Hudson, but, if they go down at a low stage of water, when the whole river is turned into the wheels of the mills, " ay, there's the rub," for in that rush of turbines what grinding comes when salmon have "jumped this bank and shoal," is more than we can say.

While holding fast to that which is good, and this means stocking the streams which have reared fish and sent them to sea in sufficient numbers to return again, I would suggest that the Sacandaga River be stocked. I know that its lower waters, especially below Mill Creek, where the new hatchery of the New York Fish Commission is located, contain pickerel (*Esox lucius*), but so does the Hudson, from Albany, up to above North Creek. If the Sacandaga is to be stocked I would say that the nearest way to reach its headwaters is via North River, 6 miles above North Creek, where the Adirondack Railroad ends, and thence by wagon to the "Drake Place," 3 miles east of Oregon, and make the plant in Diamond Mountain Brook and in Siamese Brook, and also in Buck Meadow Brook and Botheration Pond. The latter is the head of the Sacandaga River. There is no need for me to write an essay on the benefits of planting salmon in the headwaters of streams where they get insect and crustacean food and escape their larger enemies.

I think that the tributaries of the Hoosic River, which enters the Hudson as low down as Stillwater, and other streams in Washington County, N. Y., might prove to be good rearing streams for salmon, but I have no personal knowledge of them. The same might be said of streams in the Catskills, of which I also know little beyond the fact that there are good trout streams there. If it is desirable to extend the number of streams to be stocked or to substitute others for those which, in my opinion, are not as good as they should be, then some competent person should make an examination of other brooks.

I do not know at what time of the year the young salmon go down past the obstructions named. If they go at low water, when at several places the great body of water goes through mill-wheels, many of them may be killed; hence my suggestion of stocking some streams lower down. If, however, the fish make the descent of the upper river at times of high water they have the choice of going over dams or through wheels. However this may be, some have escaped, and the stocking of the Hudson with salmon is one of the successes of fish culture with which I feel proud to have been connected.

62.—SOME REASONS WHY THE FISHERMEN OF NOVA SCOTIA PREFER TO USE SALT CLAMS (MYA ARENARIA) FOR BAIT IN THE BANK HAND-LINE COD FISHERIES.[1]

By J. W. COLLINS.

About thirty years ago the method of fishing with hand-lines from dories was adopted by those cod fishermen of the United States who resorted to the Great Bank of Newfoundland and to other large fishing grounds lying east of the sixty-third meridian of west longitude. This dory fishing superseded the method of fishing with hand-lines from the deck of a vessel, and, since the men could work over a larger area in their boats, more profitable returns were obtained than could be secured by the old-fashioned style of fishing.

In recent years Nova Scotia has employed many vessels in the dory hand-line cod fishery on the ocean banks. The rapid growth of this fishery from that province is probably largely due to the decline of the Labrador cod fishery and the fact that excellent fares of cod can be obtained by this method of fishing, with comparatively small expense for outfit.

The dory hand-line fishermen of Nova Scotia, like those of New England, use for bait salt clams (*Mya arenaria*). This is the bait *par excellence* of the dory hand-liner, and to say that a vessel will engage in the bank hand-line cod fishery is to say that she will carry a supply of salt-clam bait.

A sufficient quantity of this kind of bait can be obtained only in the United States. It is true that the soft clam occurs in the British Provinces, more especially in the Bay of Fundy, but nowhere is it abundant enough to furnish a supply much beyond that required for the tables of the local residents. The eastern limit where it is found sufficiently abundant for bait purposes is at Machias, Me. In the Machias customs district 20,100 bushels were dug in 1880, while the product of the Eastport customs district during the same year was only 1,500 bushels.

"In the Bay of Fundy, however, they were constantly dug in sufficient quantity for household use," remarks Ingersoll. But the same authority states that the "absence of extensive mud flats bordering the sea along this precipitous and rock-bound coast makes it unsuitable for the growth of clams to any great extent until the Bay at Jonesport, Me., is reached, where, between that town and Rogue Island, are very important diggings."[2]

It will thus be seen that the procurement of salt-clam bait from the region east of Machias is practically out of the question, and the limited quantity which might be obtained by special exertion would cost more in time or money than any fisherman could afford.

---

[1] These notes were prepared for the use of the Commissioners who negotiated the fishery treaty between the United States and Great Britain in the winter of 1887-'88, and which was rejected by the Senate of the United States.

[2] The Fishery Industries of the United States, sec. v, Vol. 2. The Clam Fisheries, by Ernest Ingersoll, p. 584.

But, even if the question of cost was not considered, it is doubtful if enough of this bait could be dug in Canadian territory to supply more than one-tenth of the provincial vessels which use it.

The reasons for the use of salt clams for bait are substantially as follows:

First, and possibly the principal reason, is that, considering the results obtained, the method of hand-line dory fishing and the use of salt-clam bait has been found the most economical method, both as regards the cost of outfit and the utilization of time.

To particularize: A vessel fitting for a hand-line cod-fishing trip to the eastern banks will carry one small dory (usually 13 feet long on the bottom) for each member of its crew, exclusive of the captain and cook. Thus a schooner having fourteen men in her crew will carry twelve dories. These will cost, including oars, etc., about $22 each, or a total of $264. The hand-lines are comparatively inexpensive, and the whole outfit of boats and lines would not much exceed $350.

The expense for bait (say 50 barrels of clams, at $5 to $6 per barrel) will vary from $250 to $300, and may possibly exceed that amount in some cases, though it is likely to fall below it.

To fit a vessel for trawling (the only other method pursued in the so-called bank cod fishery) will cost from $1,000 to $1,300 for boats and other apparatus, while the expense for fresh bait is generally much greater than that incurred by a schooner of the same size employed in hand-line fishing.

It will thus be seen that from $700 to $1,000 are saved in the outfit of a dory hand-liner as compared with the trawler. And it is easy to see, also, that if the former gets the same amount of fish, which is often the case, the profits of the voyage will be that much greater.

It is an important consideration that the use of salt clams prevents the fishermen from losing any time in looking after supplies of bait, since all that is needed for the voyage is carried on board, and it is so well preserved that it will not deteriorate. When "baitings" of fresh herring, squid, or capelin must be obtained, much time is often lost in waiting for these species to "strike in" near the harbors where the vessels go to seek them. It is not uncommon for vessels which depend solely on getting supplies of fresh bait near the land to spend more time in quest of it than they do in fishing on the banks.

This being the case, it follows that though the daily catch of a vessel using salt clams may be somewhat less than that of one having fresh bait (while both are fishing together), the monthly catch of the former might still be the largest.

It will thus be seen that both time and money are saved by the method of dory hand-line fishing. It would take too long to show here why this method has not been more universally adopted, but it may be said that the chief reason, so far, has been that the fish taken are somewhat smaller, on an average, than those caught on trawl lines, and the demand for large cod in the American markets has heretofore offset some of the advantages to be derived from the less expensive hand-line fishery.

Second. As previously stated, up to the present time salt clams are preferred to any other bait that can be carried on a vessel for the bank hand-line fishery.

Salt squid have sometimes been used, but these make far less desirable bait, and I have known of no instance when the fishermen did not depend for the successful issue of a voyage upon having a supply of salt clams.

It is unquestionably true that if a full supply of fresh bait, suitable to the cod, could be obtained each morning on the bank, *direct from the water*, it would be found far more profitable to use it than it would be to use salt clams. And it is a well-known fact that the hand-line fishermen do use such fresh bait as they can procure on the fishing ground, often mixing this with their salt bait, or, if the supply of fresh material is sufficient to warrant it, they employ no other lure. Sometimes enough squid are caught to furnish all the bait required, and at other times the contents of the cod's stomach (bank clams, lant, and capelin) are carefully secured to use on the next day. Occasionally birds may be caught to eke out the supply of bait, or a porpoise may be killed for the same purpose. But birds and porpoises are more in favor with that class of cod trawlers called "shack fishermen" than they are with the handliners.

But, though it has generally been found desirable to utilize such supplies of fresh bait as could be obtained on the fishing grounds, it thus far seems that fresh frozen or iced bait—carried out from the land—can not be advantageously used by the hand-line fishermen.

The reason is this: While fish or mollusks taken fresh from the water will generally keep in pretty fair condition through the day, so that they can be used successfully by the dory fisherman (who, of course, has no means of protecting his bait from the effects of exposure to the air), bait which has been frozen or iced will speedily deteriorate when exposed to atmospheric action in spring or summer. Placed unprotected in an open boat, as it necessarily must be for the dory fishermen, it becomes offensive and worthless before the day's fishing is fairly begun.

For this reason, and also because the cod on the eastern banks is specially fond of mollusks, the salt clam, which *always* retains its flavor, is really far more attractive to the fish and more serviceable to the fishermen than fresh bait which has been packed in ice. In a word, it is believed that more fish can be caught by a crew of hand-line fishermen who are provided with salt clams than can be taken by a similar crew having fresh iced bait; and this, too, when both are at work, and excluding from the question the loss of time, etc., which must result from the attempt to obtain supplies of fresh bait from the baiting stations of the British Provinces.

The reason why fresh bait packed in ice can be more successfully used by the trawl fishermen and hand-liners who fish on George's Bank from the decks of their vessels is because it is seldom exposed to the air very long before it is put into the water.[1]

As an example of the success which is sometimes attained by the use of salt-clam bait, both in the hand-line and trawl fisheries for cod and as an illustration of the importance to American fishermen of this resource for a bait supply, the following list of catches is given, made by vessels which arrived at Gloucester, Mass., from bank trips in the early part of the season of 1887.

As will be seen, large fares were obtained by these vessels, and that, too, in the spring, when very little, if any, fresh bait could be obtained on the fishing ground.

Vessels of the New England codfishing fleet using salt-clam bait, spring, 1887.

Name of vessel.	Name of bank.	Apparatus used.	Catch of cod.	Catch of halibut.	Name of owner.	Date of arrival at Gloucester.
			Pounds.	*Pounds.*		
Mabel Kenniston	Western	Hand-line.	125,000	5,000	D. Allen & Son	May 18.
Bounding Billow	do	Trawl	90,000	1,000	Shute & Merchant	Do.
E. A. Foster (of Beverly)	do	do	125,000	2,000	Foster & Co	May 20.
Plymouth Rock	do	do	150,000	2,000	George Steele	Do.
Marguerite	do	do	180,000	2,000	J. F. Wonson & Co	May 23.
Susie Hooper	do	Hand-line	80,000	1,000	D. Allen & Son	May 26.
Stranger	Grand	do	70,000	20,000	Geo. H. Perkins & Co	May 30.
E. F. Bartlett	Western	do	70,000	800	George Thurston	Do.
John S. Presson	do	do	240,000	1,500	George Clark	June 4.
D. A. Wilson (of Beverly)	do	do	140,000	1,000		Do.
Geo. F. Keene (of Maine)	do	do	125,000	800		Do.
H. A. Duncan	Grand and Western.	do	150,000	2,000	George Steele	June 6.
Flying Scud	do	do	100,000	1,500	J. O. Proctor, jr	June 9.
Schuyler Colfax	do	do	76,000		do	June 10.
Hattie S. Clark	do	do	140,000		do	Do.
C. P. Thompson	do	do	125,000	300	B. Low	June 18.
J. W. Collins	do	do	140,000		D. Allen & Son	June 28.
Sir Knight (of Maine)	do	do	130,000		Master	Do.
Uncle Jo (of Maine)	do	do	100,000		do	June 20.
E. R. Nickerson (of Me.)	do	do	76,000		do	Do.

New England fishing vessels visiting those banks in 1887 carried salt, clam bait, many using no other. Some vessels, up to June 1, used salt-clam bait and bank clams taken from the fish caught. From June 1 to August 15 they used salt clams and such other material as could be obtained on the banks. From August 15 to the close of the season squid were found in great abundance on all the banks.

On some of the trips of the season some of the vessels carried salt clams and frozen herrings.

---

[1] For details of the dory hand-line cod fishery see the chapter on the "Bank Hand-line Cod Fishery," pages 123 to 133, Vol. I, section 5, of the quarto report on the Fisheries of the United States.

63.—A REVIEW OF THE MACKERELS (SCOMBRINÆ) OF AMERICA AND EUROPE.

By FLETCHER B. DRESSLAR and BERT FESLER.

In this paper we give the principal synonymy of the genera and species of the family *Scombrinæ*, found in America and Europe, together with analytical keys for the separation of the genera and the identification of the species.

The specimens studied by us belong to the museum of Indiana University, and were mostly collected by Professor David S. Jordan. Duplicate series of most of the species are in the U. S. National Museum.

The paper was prepared under the direction of Dr. Jordan, to whom we are indebted for aid of various kinds.

We adopt the family of *Scombridæ* as defined in Jordan and Gilbert's "Synopsis of the Fishes of North America." The true mackerels belong to a subfamily, or perhaps family, *Scombrinæ*, which may be defined thus:

Body elongate, little compressed, covered with small scales or partly naked; the scales about pectoral region generally enlarged, forming a "corselet." Lateral line always present, usually more or less undulating. Head conical. Mouth terminal, rather large. Premaxillary not protractile; maxillary with no supplemental bone. Jaws armed with sharp teeth, of varying size and form. Opercles without spines or denticulations. Gill-openings wide, a slit behind the fourth gill; gill-membranes separate, free from isthmus. Pseudobranchiæ large. Branchiostegals 7. Dorsal fins separate, the spines slender, decreasing in length and strength posteriorly; depressible in a groove; second dorsal of soft rays similar to anal; soft dorsal and anal followed by a series of detached finlets. Caudal peduncle long, slender, usually with lateral keel. Caudal fin large, very deeply forked; caudal lobes narrow, abruptly diverging. Ventral fins thoracic, of moderate size, I, 5. Vertebræ numerous, 31 to 66. Pyloric cœca present, numerous. Air-bladder small or wanting. Sexes similar. Coloration always metallic, often very brilliant. Fishes having a wide range. This definition excludes *Gempylus* and its relatives, elongate species, destitute of finlets, intermediate between the true *Scombrinæ* and the *Trichiurinæ*. There are in *Scombrinæ*, as here restricted, nine genera and about sixty species.

In addition to the eight below-mentioned genera is an Asiatic genus, *Grammatorcynus*, which differs from *Albacora* in having a double lateral line and fewer dorsal spines and finlets.

ANALYSIS OF AMERICAN AND EUROPEAN GENERA OF SCOMBRINÆ.

Finlets present (5 to 10 in number) behind soft dorsal and anal; body not greatly elongate. (*Scombrinæ.*)

a. Caudal peduncle without median keel; dorsals well separated, the interspace being less than two in head; spinous dorsal short, of 9 to 12 spines; body scaly; vertebræ normal; slender teeth on vomer and palatines; maxillary entirely covered by preorbital; a fleshy lobe on each side of the lower jaw near its junction with the maxillary; corselet very small or obsolete; gill-rakers long, slender, and numerous; vertebræ 14 + 17 = 31 .... SCOMBER, 1.

aa. Caudal peduncle with median keel; a small keel above and one below this.

  b. Body scaleless, excepting on and about the lateral line and corselet; dorsal spines 10 to 16; "abdominal vertebræ with their lower foramina enlarged, and a portion between the vertebræ proper and the hæmapophyses developed in the form of a net-work or trellis."

    c. Dorsals well separated, the interspace less than 2 in head; corselet well developed; teeth small, some present on vomer, none on palatines; gill-rakers long, slender, and numerous; vertebræ 39 .... AUXIS, 2.

    cc. Dorsals contiguous, the interspace more than 5 in head; palatine teeth villiform.

      d. Vomer with teeth; dorsal spines 11 to 13 .... ORCYNOPSIS, 3.

      dd. Vomer toothless; dorsal spines 15 to 16; vertebræ 38 ..... GYMNOSARDA, 4.

  bb. Body wholly covered with small scales, those on the corselet and lateral line sometimes larger; dorsal spines 14 to 26; vertebræ normal.

    e. Teeth of jaws slender, subconical, little, if at all, compressed; gill-rakers numerous; corselet distinct.

      f. Vomer and palatines with villiform or sand-like teeth; body robust, not compressed; vertebræ 39 to 41 .... ALBACORA, 5.

      ff. Vomer toothless; palatines with a single row of rather strong, conical teeth; body elongate, slightly compressed; vertebræ 50 to 54. SARDA, 6.

    ee. Teeth of jaws strong, subtriangular or knife-like, more or less compressed; villiform teeth on vomer and palatines; gill-rakers comparatively few; corselet obscure.

      g. Dorsal spines 14 to 18; body elongate, compressed; head short; snout short; vertebræ 45 .... SCOMBEROMORUS, 7.

      gg. Dorsal spines 24 to 26; body elongate, fusiform; snout long; vertebræ 32 + 34 = 66 .... ACANTHOCYBIUM, 8.

Genus I.—SCOMBER.

Scomber Artedi, Genera, 30, 1738.
Scomber Linnæus, Syst. Nat., ed. x, 297, 1758 (*scombrus*).
Pneumatophorus Jordan & Gilbert, Proc. U. S. Nat. Mus., 593, 1882 (*pneumatophorus*).

TYPE: *Scomber scombrus* Linnæus.

Etymology: σχόμβρος, Latin, *Scomber*, name of the common mackerel.

This well-known genus contains but few species, two of which are common in the North Atlantic, one of them being one of the most valuable of food fishes. It is divisible into two subgenera, on the character of the air-bladder.

ANALYSIS OF SPECIES OF SCOMBER.

a. Air-bladder wanting (*Scomber*).

  b. Dorsal spines, 11 or 12; skull with inconspicuous parallel ridges; subopercle somewhat triangular; posterior border of eye not covered by radiating scales; top of head without translucent area; about 15 or 20 small black specks or mucous pores at base of preopercle, generally arranged in a single row; upper part of body of a dark blue color, shading into green; the back and the sides to some distance below the lateral line are marked with about 35 dark wavy stripes; gill-covers and maxillary bones silvery; belly whitish; a longitudinal groove connecting dorsals; first dorsal about as high as long, and when unexpanded is almost wholly concealed in a groove at its base; the height of second dorsal is about one-third its length; both dorsals margined with white; head 3 in body, to base of caudal; depth, 3½; D. XI, 12–V; A. 12–V .... SCOMBRUS, 1.

aa. Air-bladder present, small. (*Pneumatophorus* Jordan & Gilbert.)

  c. Dorsal spines, 9 or 10; skull perceptibly ridged, but ridges not parallel; subopercle rather more elliptical than triangular; posterior border of eye covered with large radiating scales; top of head with a large translucent area; more than 20 black specks or mucous pores on base of preopercle, generally arranged in more than one row; dark blue above, with a shading of light green; about 30 dark wavy streaks passing down the sides to just below the lateral line; sides with soiled mottlings and dusky spots; belly and gill-covers silvery; no longitudinal groove connecting dorsals; first dorsal higher than long, with the last spines short and weak; second dorsal twice as long as high; head 3 in body to base of caudal; depth, 3¼; D. IX or X, 12–V; A. I, 12–V .... COLIAS, 2.

1. SCOMBER SCOMBRUS.

(THE COMMON MACKEREL.)

Scomber scombrus Linnæus, Syst. Nat., ed. x, 297, 1758 (after Artedi: and of the copyists); Cuv. & Val., viii, 6, 1831 (Mediterranean); Steindachner, Ichthy. Berichte, v, 1, 1868 (Spanish coast); Gill, Cat. Fish. East Coast, Rept. U. S. Fish Com., 802, 1872; Baird, Rept. U. S. Fish Com., 825, 1872 (Wood's Holl); Bean, Proc. U. S. Nat. Mus., 25, 1879 (Bergen, Norway); Bean, Proc. U. S. Nat. Mus., 88, 1880 (Wood's Holl; Portland, Me.; no description); Goode, Fish and Fisheries, 95, 1881; Jordan & Gilbert, Proc. U. S. Nat. Mus., 44, 1881; Jordan & Gilbert, Proc. U. S. Nat. Mus., 592, 594, 1882 (doubtfully reported from Santa Barbara, Cal.); Jordan & Gilbert, Synop. Fish. N. A., 424, 1883; Stearns, Proc. U. S. Nat. Mus., 124, 1883 (Triangle Harbor, Labrador); Goode, Nat. Hist. Aquat. Anim., 281, pl. 91, 1884 (Provincetown, Mass.).

Scomber scomber, Linnæus, Syst. Nat., xii, 492, 1766; Brünnich, Ichthy. Massil., 68, 1768; Bloch, Ichthyol., taf. 54; Bloch & Schneider, 24, 1801 (Baltic); Günther, ii, 357, 1860 (Lisbon, mouth Thames).

Scomber vernalis Mitchill, Trans. Lit. and Phil. Soc. New York, i, 423, 1815 (Sandy Hook); Cuv. & Val., viii, 48, 1831 (after Mitchill); Storer, Fish. Mass., 41, 1839 (Boston); De Kay, New York Fauna, Fishes, 101, pl. 12, f. 34, 1842 (New York); Storer, Hist. Fish. Mass., 132, 1867 (Long Point).

Habitat.—Temperate seas; north to Norway and Labrador; south to the Mediterranean and Santa Barbara. The specimens examined by us are from Wood's Holl and the Washington Market.

Etymology: σκόμβρος, the mackerel.

This species is very abundant along our North Atlantic coast, great quantities being taken every season. It is a valuable food-fish. It attains a length of 16 or 17 inches, and a weight of 2 to 3 pounds.

2. SCOMBER COLIAS.

(CHUB MACKEREL; TINKER MACKEREL; SPANISH MACKEREL OF EUROPE; THIMBLE-EYED MACKEREL.)

Lacerto Cetti, "Hist. Nat. Sard., iii, 190, 1774."

Scomber colias Gmelin, Syst. Nat. (Sardinia), 1329, 1788 (based on Cetti); Cuv. & Val., viii, 39, pl. 209, 1831 (Naples); Storer, Fishes Massachusetts, 45, 1839; De Kay, N. Y. Fauna, Fish. 104, pl. 11, f. 33, 1842 (New York); Günther, ii, 361, 1860 (Lisbon); Steindachner, Ichthyologische Notiz., vii, 25, 1868 (coast of Chili); Steindachner, Ichthyologische Berichte, v, 3, 1868 (Spain, Portugal); Gill, Cat. Fish, East Coast N. A., U. S. Fish Com. Rept., 802, 1872; Steindachner, Ichthyologische Beiträge, iii, 53, 1875; Jordan & Gilbert, Proc. U. S. Nat. Mus., 592, 1882 (Charleston, S. C.); Jordan & Gilbert, Proc. U. S. Nat. Mus., 268, 1882; Jordan, Proc. U. S. Nat. Mus., 143, 1883 (Pensacola); Goode, Nat. Hist. Aquat. Anim., 303, pl. 91, f. 2, 1884 (Provincetown, Mass.); Jordan, Proc. U. S. Nat. Mus., 39, 1884 (name only); Steindachner & Döderlein, Beiträge zur Kenntniss der Fische Japan's, iii, 9, 1885 (Tokio); Jordan, Proc. U. S. Nat. Mus., 373, 1885 (Cape San Lucas; no description); Jordan, Proc. U. S. Nat. Mus., 574, 1886 (no description).

Scomber lacertus Walbaum, Art. Pisc., 209, 1792 (after Cetti).

Scomber pneumatophorus de la Roche, "Annal. Mus. Hist. Nat., xiii, 315, 334, 1809" (Balearic Islands); Cuv. & Val., viii, 36, 1831; Günther, ii, 359, 1860 (St. Helena, Madeira); Poey, Enumer. Pisc. Cubens., 73, 1875; Bean, Proc. U. S. Nat. Mus., 25, 1879 (Canaries); Bean, Proc. U. S. Nat. Mus., 88, 1880 (Provincetown, Mass.; no description); Jordan & Gilbert, Proc. U. S. Nat. Mus., 456, 1880 (Monterey Bay; no description); Jordan & Gilbert, Proc. U. S. Nat. Mus., 45, 1881 (Monterey); Jordan & Gilbert, Proc. U. S. Nat. Mus., 593–594, 1882 (Santa Barbara, Cal.); Jordan & Gilbert, Synop. Fish. N. A., 424, 1883; Jordan, Cat. Fish. N. A., 68, 1885.

Scomber macrophthalmus Rafinesque, Indice d'Ittiologia Siciliana, 53, 1810 (Palermo).

Scomber grex Mitchill, Trans. Lit. and Phil. Society N. Y., 422, 1815 (New York); Cuv. & Val., viii, 45, 1831 (Brazil); De Kay, New York Fauna, Fishes, 103, pl. 11, f. 32 (New York); Jordan & Gilbert, Proc. U. S. Nat. Mus., 267, 306, 1882 (Pensacola); Jordan & Gilbert, Proc. U. S. Nat. Mus., 374, 1882 (Panama).

Scomber maculatus Couch, "Mag. Nat. Hist., v, 22, f. 8, 1832."

Scomber diego Ayers, Proc. Cal. Acad. Sci., i, 92, 1856 (Santa Barbara); Gill, Proc. Acad. Nat. Sci. Phila., 260, 1862 (Lower California); Jordan & Gilbert, Proc. U. S. Nat. Mus., 456, 1880 (name only); Jordan & Gilbert, Proc. U. S. Nat. Mus., 268, 1882 (Southern California).

Scomber dekayi Storer, Hist. Fish. Mass., 130, pl. 11, f. 1, 1867 (Massachusetts coast); Kidder, Proc. U. S. Nat. Mus., 314, 1879 (Provincetown).

Habitat.—Warm seas, north to Southern Europe, Cape Cod, Monterey, and Japan, south to Chili. The specimens examined by us are from the Massachusetts coast, Block Island, Santa Barbara, Albemarle Island, Galapagos, and Venice.

Etymology: *Colias*, Latin name, probably of this species; bastard tunny.

This well known species, common in the Mediterranean, is of rather irregular occurrence on our Atlantic coast. It is a good food-fish, but of far less importance than its congener. In our opinion Dr. Steindachner is quite right in regarding the *Scomber pneumatophorus* as identical with *S. colias*.

One of the specimens before us, collected at Block Island by Professor Seth E. Meek, shows a remarkable union of the characters of *S. scombrus* and *S. colias*, and is probably a hybrid between the two. It is 13½ inches in length. The following are its characters:

Description of a supposed hybrid, scombrus-colias.

D. XII, I–10–IV; A. I, 11–IV. The hindmost finlets are double, as is the case with *S. scombrus*. The ridges on its head are in three parallel lines, ≡, as in *scombrus*, not ⋙—, as in *colias*. Subopercle more elliptical than triangular. Posterior border of eye not covered with large radiating scales. Top of head, as in *S. scombrus*, without translucent area. About 20 small black specks or pores at base of preopercle, arranged in a single row. Coloring on the back in blotches, as in *colias*, rather than in stripes, as in *scombrus*. Sides mottled, much as in *colias*. No longitudinal groove between the dorsals. A black axillary spot. Snout more like *scombrus* than *colias*. Base of pectorals dark. Ventrals and pectorals short. Eye, 5 in head. Head, 4 in length to fork of caudal fin. Body robust, as in *colias*. Caudal peduncle round, as in *colias*, rather than depressed, as in *scombrus*. The following note was made by Professor Seth E. Meek, the collector: "September 16, Block Island. A peculiarly marked *Scomber scombrus*, only four finlets, no air-bladder, low, spinous dorsal, and markings of *S. colias*. Blackford thinks it is a cross between the two."

Genus II.—AUXIS.

Auxis Cuvier, Règne Animal, ed. ii, 119, 1829 (rochei).

TYPE: *Scomber rochei* Risso = *Scomber thazard* Lacépède.

Etymology: αὔξις, a kind of tunny; from αὔξω, to grow.

This genus, in some degree intermediate between *Scomber* and *Gymnosarda*, probably contains but a single species.

ANALYSIS OF SPECIES OF AUXIS.

a [Body robust, scarcely compressed, abruptly contracted at caudal peduncle. Eye as long as snout, 5 in head. Opercle very broad. Scales of corselet and along anterior dorsal region comparatively large. Maxillary almost entirely concealed by preorbital. Dorsal spines rather stiff; the space between dorsals ½ length of head. Gill-rakers x + 33. Pectorals reaching past middle of first dorsal. Head 4 in length; depth, 4½. D. x–12–VIII; A. 13–VII. Vertebræ, 39. Blue, variegated with darker above, becoming plain with age; belly silvery.] (*Jordan & Gilbert*)..THAZARD, 3.

3. AUXIS THAZARD.

(THE FRIGATE MACKEREL.)

Scomber thazard Lacépède, Hist. Nat. Poiss., iii, 9, 1802 (6° and 7° south lat., coast of New Guinea).

Auxis thazard Jordan & Gilbert, Synop. Fishes N. A., 911, 1883; Goode, Nat. Hist. Aquat. Anim., 305, pl. 92, f. 1, 1884 (Newport, R. I.); Jordan, Proc. U. S. Nat. Mus., 574, 1886. (No description.)

Scomber rochei Risso, Ichth. Nice, 165, 1810 (Nice).

Auxis rochei Günther, ii, 369, 1860 (Jamaica; Amboyna); Steindachner, Ichthyologische Berichte, v, 10, 1868 (Lisbon, Cadiz, Malaga); Goode, Proc. U. S. Nat. Mus., 532, 1880 (Block Island); Jordan & Gilbert, Synop. Fishes N. A., 424, 1883; Steindachner & Döderlein, Beiträge, iii, 12, 1885 (Japan).

Scomber bisus Rafinesque, Caratteri, etc., 45, pl. 2, f. 1, 1810 (Palermo).

Auxis bisus White, "Catal. Brit. Fishes, 32, 1851."

Thynnus rocheanus Risso, "Eur. Mérid., iii, 417, 1826."

Auxis taso Cuv. & Val., viii, 146, 1831 (New Guinea; after Lacépède).

Auxis vulgaris Cuv. & Val., viii, 139, 1831 (Mediterranean); Lowe, Proc. Zool. Soc., 248, 1850 (Madeira).

Auxis thynnoides Bleeker, "Ternate, v, 301, 1855" (Ternate).

Auxis tapeinosoma Bleeker, "Fauna, Japan, 408, 1854; Verhand. Batav. Genootsch., xxvi, 98, tab. 7, f. 1, 1846 (Japan); Günther, ii, 369, 1860 (Sea of Japan, copied).

Habitat.—All warm seas; occasionally northward to Cape Cod.

Etymology: *Thazard*, from the French *Tassard*, a name of *Scomberomorus*.

This species is very erratic in its movements, swimming in large schools. It rarely reaches our coast, but then in immense numbers. It is a poor fish, of little value as food. If all the species of *Auxis* are identical, the oldest specific name is that of *thazard*. The specimen examined by us is from the island of St. Lucia.

Genus III.—ORCYNOPSIS.

Orcynopsis Gill, Proc. Acad. Nat. Sci. Phila., 125, 1862 (*unicolor*).

TYPE: *Scomber unicolor* Geoffroy-St.-Hilaire.

Etymology: ὀρκύνος, Orcynus, the Tunny; ὄψις, appearance.

This genus is based on a single species found in the Mediterranean. Its vertebræ have not been examined, but they will probably be found to have the same character as those of *Gymnosarda*, from which genus *Orcynopsis* differs but little.

ANALYSIS OF SPECIES OF ORCYNOPSIS.

a. [Body robust, compressed. About 20 teeth in each jaw. Maxillary extends to posterior margin of pupil. Corselet small, with rudimentary scales. Eyes small. Distance between first and second dorsal equal to the eye. Dorsal spines subequal. Anal inserted behind vertical from the soft dorsal. Soft dorsal and anal falcate, the last rays rapidly shortened. Head short, 5 in length; depth, 3¼. D. XIII–14–VIII; A. 14–VII. Back bluish; belly silvery-gray; spinous dorsal deep black; pectoral black posteriorly.] (*Collett*)...................UNICOLOR, 4.

4. ORCYNOPSIS UNICOLOR.

Scomber unicolor Geoffroy-St.-Hilaire, "Descr. Ég. Poiss., pl. 24, f. 6, 1827" (Egypt).
Pelamys unicolor Guichenot, Explor. Algér., Poiss., 58, 1850; Günther, ii, 368, 1860 (Mediterranean Sea).
Cybium bonaparti Verany, "Atti dell' ottava riunione degli scienziati Ital., Genova, 493, 1846."
Pelamys bonaparti Filippi and Verany, Memor. della Real. Accad. scienze di Torino, ser. 2, t. xviii, 1857.
Thynnus peregrinus Collett, Meddelelser om Norges Fiske, 20, pl. 1, 1879 (Christiania).

Habitat.—Mediterranean Sea; once taken at Christiania, Norway.

Etymology: *unus*, one; *color*, color.

This species is known to us from descriptions only.

Genus IV.—GYMNOSARDA.

Gymnosarda Gill, Proc. Acad. Nat. Sci. Phila., 125, 1862 (*unicolor* = *nuda*).
Thynnus Lütken, Spolia Atlantica, 460, 1880 (*pelamys*; not of Cuvier nor of Fabricius).
Thynnichthys Giglioli, Cat. dei Pesci Italiani, 25, 1880 (*thunnina*; not of Bleeker, a genus of CYPRINIDÆ).
Euthynnus Lütken, MSS. in Syn. Fish. N. A., Jordan & Gilbert, 429, 1883 (*thunnina*).

TYPE: *Thynnus unicolor* Rüppell = *Pelamys nuda* Günther.

Etymology: *γυμνός*, naked; *σάρδα*, *Sarda*, an allied genus.

We adopt this neglected name of Dr. Gill, instead of *Euthynnus*, because the descriptions of *Gymnosarda nuda*, especially that given by Dr. Klunzinger (Fische des Rothen Meeres), agree in all generic respects with the type of *Euthynnus*. The names *Thynnus* and *Thynnichthys* are, of course, ineligible for any mackerels, being preoccupied in other departments of zoology. The three or four species of small tunny which constitute this genus are tropical in distribution and of little value as food.

ANALYSIS OF SPECIES OF GYMNOSARDA.

a. Lateral line making a decided curve immediately beneath the second dorsal. Corselet strongly developed, covering the entire space between the diagonals connecting the posterior extremity of the spinous dorsal and the base of the pectorals. Posterior margin of preopercle about 1¼ in inferior margin. Pectorals reach the vertical from the tenth dorsal spine. Back bluish; belly silvery; four brownish stripes on each side of belly, parallel with the lower curve of the body; no spots below the pectorals. Body oblong, robust. Head 3¼; depth 4. D. XV-12-VIII; A. II, 12-VII .... PELAMIS, 5.

aa. Lateral line nowhere making a very distinct curve. Corselet well developed, not covering the entire space between the diagonals connecting the posterior extremity of the spinous dorsal and the base of the pectorals. Posterior margin of preopercle about 2 in inferior margin. Pectorals reach the vertical from the ninth dorsal spine. Bluish above; sides and belly silvery; no stripes of any kind below the lateral line; above the lateral line several wavy, oblique streaks; five round black spots about as large as pupil below the pectoral. Body fusiform, robust. Head 3¾; depth 4½. D. XV-I, 12-VIII; A. 12-VII.

ALLETTERATA, 6.

5. GYMNOSARDA PELAMIS.

(OCEANIC BONITO.)

Scomber pelamis Linnæus, Syst. Nat., x, 297, 1758 ("in Pelago inter Tropicos"); Linnæus, Syst. Nat., i, 492, 1766.

Thynnus pelamis Steindachner, Ichth. Berichte, v, 7, 1868.

Scomber pelamides Lacépède, Hist. Nat. Poiss. iii, 14, 1802 (after Linnæus).

Thynnus pelamys Cuv. & Val., viii, 113, 1831 (Rio Janeiro and Indian Ocean).

Orcynus pelamys Poey, Synopsis, 362, 1868; Poey, Enum. Pisc. Cubens., 72, 1875; Goode and Bean, Proc. U. S. Nat. Mus., 24, 1878 (Provincetown, Mass.); Bean, Proc. U. S. Nat. Mus., 89, 94, 1880 (Wood's Holl, Bermuda; no description); Goode, Nat. Hist. Aquat. Anim., 316, 319, pl. 95 B, 1884 (Provincetown and Wood's Holl, Mass.).

Euthynnus pelamys Jordan and Gilbert, Syn. Fish. N. A., 430, 1883; Jordan, Proc. U. S. Nat. Mus., 574, 1886 (no description).

Habitat.—Warm seas; north to Cape Cod and Bermudas.

Etymology: πέλαμις, tunny.

This species is scarce on the American coast, and rather more common in Southern Europe. As its name was originally spelled *pelamis*, we retain that orthography.

6. GYMNOSARDA ALLETTERATA.

(LITTLE TUNNY, ALBACORE, BONITO.)

Scomber alletteratus Rafinesque, Caratteri Alcuni Genere, etc., 46, 1810 (Palermo).

Scomber aletteratus Rafinesque, Indice Ittiologia Siciliana, 20, 1810.

Orcynus alliteratus Gill. Cat. Fish. East Coast N. A., U. S. Fish Comm., 802, 1873; Baird, Rept. U. S. Fish Comm., 825, 1873 (Wood's Holl); Goode & Bean, Proc. U. S. Nat. Mus., 24, 1878; Goode & Bean, Proc. U. S. Nat. Mus. 128, 1879 (Pensacola); Goode & Bean, Proc. U. S. Nat. Mus., 237, 1882 (name only); Bean & Dresel, Proc. U. S. Nat. Mus., 155, 1884.

Euthynnus alliteratus Jordan & Gilbert, Syn. Fish. N. A., 430, 1883; Jordan, Proc. U. S. Nat. Mus., 34, 120, 1884 (Key West); Jordan, Bull. U. S. Fish Comm., 77, 1884 (Key West; no description).

Thynnus leachianus Risso, Eur. Merid., iii, 414, 1826 (Nice).

Scomber quadripunctatus Geoffroy-St.-Hilaire, "Descr. Egypt. Poiss., tab. 24, f. 3, 1827" (Egypt).

Thynnus thunnina Cuv. & Val., viii, 104, 1831 (Mediterranean); Günther, ii, 364, 1860; Steindachner, Ichthyologische Berichte v, 6, 1868.

Thynnichthys thunnina Giglioli, Cat. dei Pesci Italiani, 25, 1880 (Naples, Messina, Trieste).

Orcynus thunnina Poey, Enum. Pisc. Cubens. 72, 1875 (Havana).

Thynnus brevipinnis Cuv. & Val., viii, 112, 1831 (Mediterranean).

Thynnichthys brevipinnis Giglioli, Cat. dei Pesci Italiani, 25, 1880 (Genoa, Palermo).

Thynnus brasiliensis Cuv. & Val., viii, 110, 1831 (Brazil).

Thynnus affinis Cantor, Cat. Malay Fishes, 106, 1850 (Sea of Pinang); Günther, ii, 363, 1860.

Habitat.—Warm seas; occasionally north to Cape Cod. The specimens examined by us are from Key West and Pensacola.

Etymology: *alleteratu*, a local Italian name at Palermo.

This species is rather common both in the West Indies and in Southern Europe. On our coast it is usually known as the bonito or little tunny. The name *alletteratus* has clear priority over *quadripunctatus* and *thunnina* and must supersede them.

Genus V.—ALBACORA.

Thynnus Cuvier, Règne Anim., 313, 1817 (*thynnus*); (not of Fabricius, a genus of butterflies).

Orcynus Cuvier, Règne Anim., 314, 1817 (*alalonga*); (not of Rafinesque (1815), which is *Scombroides*, Lacépède.)

Orycnus Gill., Proc. Acad. Nat. Sci. Phila., 125, 1862 (*alalonga*; misprint for ORCYNUS).

Orcynus Cooper, Proc. Cal. Ac. Nat. Sci., 1863, 77 (*alalonga*).

Orycnus Cooper, l. c. (*thynnus*).

Albacora Jordan, Manual of Vertebrates, edition v, 1889 (*thynnus*).

Germo Jordan, Proc. Ac. Nat. Sci. Phila., 1888 (*alalonga*).

TYPE: *Scomber thynnus* Linnæus.

Etymology: Albacora, the Portuguese name, said to be from *bacora*, a little pig, a Moorish word, preceded by the article *al*.

This genus consists of probably but two species, one of them the largest of all the bony fishes, the other similar in technical respects, but quite different in general appearance, and certainly to be placed in a different subgenus. The early generic names applied to this group *Orcynus* and *Thynnus* are both preoccupied. We have therefore adopted the name *Albaçora* lately proposed by Dr. Jordan.

In a recent paper on "the proper generic name of the Tunny and Albicore" (Proc. U. S. Nat. Mus. 1888, 319), Dr. Gill proposes to substitute the name *Orycnus*, of Cooper, for *Albacora*, as the generic name both of the Tunny and the long-finned Albacore.

It seems to us that this undesirable name should be set aside. The name *Orycnus* was first used by Dr. Gill, in 1862. It was due to a misreading of Cuvier's name, *Orcynus*, and it should be placed in the category of emendations of that name. If the name itself is preoccupied, erroneous or variant spellings of it, due to misprints, misreadings or purism ought to be preoccupied also. *Orcynus* had been previously used when Cuvier gave it as the name of the long-finned Tunnies. To spell it *Orycnus* does not save it.

But in 1863 the name "*Orycnus*" was, in the words of Gill, "specifically and with *malice prepense* resurrected and proposed for retention by Cooper." Cooper, however, proposed to use it for a group typified by the Tunny (*thynnus*), and not for the *alalonga*, for which he retained the name of *Orcynus*, given it by Cuvier.

The name *Orycnus* Cooper, it seems to us, is preoccupied by its previous use for another genus, or subgenus, by Gill. It is therefore ineligible. In other words, a generic name originating in a misprint of a well-known name can not be later used as a name of another genus.

That the two genera are now generally merged into one does not specially affect the case. Each generic name has its own typical species, and the two species should be placed in different subgenera at least.

It may be urged that the argument for rejection of the name *Orycnus* is based on a trifling technicality. This may be true, but it is true of the reasoning by which *Orycnus* could be retained instead of *Albacora*. The burden of proof rests against a name having such an origin as the former.

The case of *Athlennes* vs. *Ablennes*, mentioned by Dr. Gill, is not quite relevant. Apparently *Ablennes*, the name intended, should stand, as against *Athlennes*, the name printed; but surely in any case, *Athlennes* would not be eligible for some other group of *Belonidæ*.

ANALYSIS OF SPECIES OF ALBACORA.

a. Pectoral fins long, saber-shaped, extending as far as first dorsal finlet; their length about 2¼ in body in adult (shorter in the young). (subgenus *Germo* Jordan). Body elliptical, elongate, and but slightly compressed. Corselet small, indistinct; caudal keel extending forward to fifth finlet from caudal; maxillary not reaching to pupil. Dorsals and anal of equal height, equal to length of second dorsal; ventrals shorter. Bluish above, silvery below, sides steel-blue; finlets yellowish, tipped with blue. Head 3¼; depth 3¼. D. xiv–14–viii; A. ii, 12–vii .... ALALONGA, 7.

aa. Pectoral fins comparatively short, reaching to about the ninth dorsal spine; their length about 6 or 7 in body in adult (shorter in the young). (subgenus *Albacora*). Body oblong, very robust. Corselet well developed, extending further back than pectorals; caudal keel extending forward to second finlet from caudal; maxillary reaching to pupil. Second dorsal and anal short, 2 in the height of the first dorsal; ventrals longer than anal. Dark blue above; beneath soiled silvery with lighter spots. Head 3¾; depth 4. D. xiv–1, 12–viii; A. ii, 12–viii .... THYNNUS, 8.

7. ALBACORA ALALONGA

(GERMON, ALBACORE, ALILONGHI, LONG-FINNED ALBACORE.)

Ala-longa Cetti, "Hist. Nat. Sard. iii, 191," 1778 (Sardinia).

Scomber alatunga Gmelin, Syst. Nat., 1330, 1788 (based on Cetti; misprint for "*alalonga*," fide Cuv. & Val.).

Orcynus alalonga Risso, "Eur. Mérid., iii, 419," 1826; Jordan & Gilbert, Proc. U. S. Nat. Mus., 456, 1880 (Monterey Bay, Santa Barbara, San Pedro; no description); Jordan & Jouy, Proc. U. S. Nat. Mus., 12, 1881 (Santa Barbara; name only); Jordan & Gilbert, Proc. U. S. Nat. Mus., 41, 42, 45, 1881 (Santa Barbara channel); Jordan & Gilbert, Syn. Fish. N. A., 428, 1883; Goode, Nat. Hist. Aquat. Anim., 320, pl. 95 A, 1884 (Banquereau); Jordan, Proc. U. S. Nat. Mus., 373, 1885 (near Mazatlan; no description); Jordan, Proc. U. S. Nat. Mus., 574, 1886 (no description).

Thynnus alalonga Cuv. & Val., viii, 120, 1831 (western coast of France); Günther, ii, 366, 1860 (Cape of Good Hope); Steindachner, Ichth. Berichte, v, 7, 1868.

Scomber germo Lacépède, Hist. Nat. Poiss., ii, 598; iii, 1, 1802 (17° S. lat., 103° west long.).

Orcynus germo Lütken, Spolia Atlantica, 474, 1880.

Thynnus atlanticus Lesson, "Voy. Coquille, Zoöl., ii, 165," 1828.

Thynnus balteatus Cuv. & Val., viii, 136, 1831 (tropical parts of Atlantic).

Orcynus balteatus Poey, Enum. Pisc. Cubens., 71, 1875 (Cuba).

Thynnus pacificus Cuv. & Val., viii, 133, 1831 (27° and 26° S. lat., 103° West long.); Günther, ii, 366, 1860 (copied from Cuv.).

Orcynus pacificus Cooper, Proc. Cal. Acad. Nat. Sci., 75, 1863 (California).

Thynnus argenti-vittatus Cuv. & Val., viii, 134, 1831.

Orcynus argentivittatus Goode, Nat. Hist. Aquat. Anim., 320, 1884.

Thynnus albacora Lowe, "Proc. Zoöl. Soc., 77, 1839, and Trans. Zoöl. Soc., iii, 4," 1842; Günther, ii, 365, 1860 (copied).

Orcynus albacora Poey, Enum. Pisc. Cubens., 71, 1875.

Thynnus macropterus Temminck & Schlegel, Fauna Japan, Poiss., 98, pl. 51, 1850.

*Orcynus subulatus** Poey, Enum. Pisc. Cubens., 71, 1875; Lütken, Spolia Atlantica, 596, 1880.

Habitat.—Warm seas; north to Japan, southern California, and the Grand Banks of Newfoundland; south to Cape of Good Hope.

Etymology: *ala*, wing; *longa*, long.

This species does not grow so large as the tunny. It is but rarely seen on our Atlantic coast, but is common in the Mediterranean. It is found on the Pacific coast as far north as San Francisco, and is abundant in the spawning season about the Santa Barbara Islands. As a food-fish it is of little value. It reaches a length of 3 feet and a weight of 20 pounds.

8. ALBACORA THYNNUS.

(TUNNY, HORSE MACKEREL.)

Albacore, Sloane, "Hist. Jam., i, 28, pl. 1, f. 1," 1727.

Scomber pinnulis 8, etc., Artedi, Genera, 31, 1738.

Scomber thynnus Linnæus, Syst. Nat., ed. x, 297, 1758 (based on Artedi); Bloch, Ichthyologia, pl. 55, 1783 (and of the various copyists).

Thynnus thynnus Günther, ii, 362, 1860 (Weymouth and Plymouth).

Orcynus thynnus Poey, Enum. Pisc. Cubens., 70, 1875; Jordan & Gilbert, Proc. U. S. Nat. Mus., 375, 1878 (Beaufort); Goode, Proc. U. S. Nat. Mus., 533, 1880 (New England); Jordan & Gilbert, Syn. Fish. N. A., 429, 1883; Goode, Nat. Hist. Aquatic Anim., 320, pl. 96, 1884 (Vineyard Sound); Jordan, Proc. U. S. Nat. Mus., 574, 1886 (no description).

Scomber albacores Bonnaterre, Tabl. Encyc. Ichth., 140, 1788 (based on Sloane).

Thynnus mediterraneus Risso, "Eur. Mérid., iii, 414," 1826.

Thynnus vulgaris Cuv. & Val., viii, 58, pl. 210, 1831 (European seas); Storer, Fishes Mass., 47, 1839 (Kettle Island, Pigeon Cape); DeKay, New York Fauna, Fishes, 105, pl. 10, f. 28. 1842; Steindachner, Ichth. Berichte, v, 7, 1860 (Spain and Portugal); Tybring, Bull. U. S. Fish Comm., 150, 1886 (Antilles).

Thynnus brachypterus Cuv. & Val., viii, 98, pl. 211, 1831 (Mediterranean); Günther, ii, 363, 1860 (copied); Steindachner, Ichth. Berichte, v, 6, 1868 (Spain and Portugal).

Thynnus coretta Cuv. & Val., viii, 102, 1831 (Caribbean Sea); DeKay, New York Fauna, Fishes, 106, 1842 (Gulf of Mexico); Günther, ii, 363, 1860 (copied).

Scomber sloanei Cuv. & Val., viii, 148, 1831 (based on Sloane).

Thynnus secundo-dorsalis Storer, Hist. Fishes Mass., 143, 1867 (Cape Ann and Provincetown).

Orcynus secundidorsalis Gill, Rept. U. S. Fish Comm., 802, 1871-'72 (Newfoundland to Florida); Baird, Rept. U. S. Fish Comm., 825, 1871-'72 (Wood's Holl); Poey, Enum. Pisc. Cubens., 76, 1875.

Orcynus schlegelii Steindachner & Döderlein, Beiträge zur Kenntniss der Fische Japan's iii, 11, pl. 3, f. 1, 1885 (Tokio).

---

* Poey, who describes this species, writes as follows of the length of the pectoral, on which point alone it fails to agree with *alalonga*; the pectoral is 1⅔ in anal, 5 in total to base of caudal, ⅓ in ventral, ⅘ in head. Lütken unites other disputed species, *albicora*, *pacificus*, *germo*, etc., with *alalonga*, and hesitates to do the same with *subulatus* only on account of the length of its pectoral, which he thinks is a little too long for *thynnus* and not nearly long enough for *alalonga*.

Habitat.—Warm seas; north to Newfoundland and Japan. The specimen examined by us is from Venice.

Etymology: *θύννος*, tunny—*thynnus.*

This species, according to Dr. Gill, reaches an average weight of 200 pounds, and a length of 8 to 10 feet. Specimens of 1,500 pounds weight are, however, on record. It is scarce off our coasts, but so abundant in Southern Europe as to be the object of very extensive fisheries. Its flesh is rather coarse, and not of superior flavor.

Genus VI.—SARDA.

Sarda Cuvier, Règne Anim., 120, 1829 (*sarda*).
Pelamys Cuv. & Val., viii, 149, 1831 (*sarda*), (not of Daudin, a genus of snakes).

TYPE: *Scomber sarda* Bloch.

Etymology: *σάρδα*=a kind of tunny caught near Sardinia.

This genus contains two closely related species, the one of the Atlantic, the other equally abundant in the Pacific.

ANALYSIS OF SPECIES OF SARDA.

a. Dorsal spines 21. Body rather elongate, moderately compressed. Maxillary reaching beyond orbit. Teeth small, slightly compressed, about 30 in each jaw. Gill-rakers small, about 11 or 12 below angle. Lateral line scarcely undulating, nowhere making any decided curve. Dark steel-blue above, silvery below; several blackish stripes running obliquely downward and forward from the dorsal region. Head 3¾; depth 4⅛. D. XXI–I, 13–VII; A. I, 13–VI ... SARDA, 9.

aa. Dorsal spines 18. Body elongate, not much compressed. Maxillary not reaching beyond orbit. Teeth strong, curved, slightly compressed, about 40 in each jaw. Gill-rakers long, equaling diameter of eye, about 16 or 17 below angle. Lateral line undulating, making a sharp angular turn below soft dorsal. Dark metallic blue; sides dusky; several blackish stripes running upward and backward from the pectoral region. Head 3¾; depth 4¾. D. XVIII–I, 12–VIII; A. I, 11–VII .... CHILENSIS, 10.

9. SARDA SARDA.

BONITO, SKIP-JACK.

Scomber pelamis Brünnich, Ichthy. Massil., 68, 1768 (Marseilles, not of Linnæus).
Scomber pelamys Tybring, Bull. U. S. Fish Comm., 149, 1886.
Scomber sarda Bloch, Ichthyologia, x, p. 35, pl. 334, 1793.
Pelamys sarda Cuv. & Val., viii, 149, pl. 217 (Cape Verde, coast of France); Storer, Rept. Fish. Mass., 49, 1839 (Holmes's Hole, Martha's Vineyard); DeKay, New York Fauna, Fishes, 106, pl. 9, fig. 27, 1842 (New York Harbor); Ayres, "Proc. Cal. Acad., 74," 1855; Günther, ii, 367, 1860 (Cape Good Hope); Günther, Fishes of Central America, 435, 1866; Storer, Hist. Fish. Mass., 141, 1867; Steindachner, Ichthyologische Berichte, v, 8, 1868.
Sarda sarda Jordan & Gilbert, Proc. U. S. Nat. Mus., 19, 1884.
Scomber mediterraneus Bloch and Schneider, 23, 1801 (after Brünnich).
Scomber pelamitus Rafinesque, Caratteri etc., 44, pl. 2, 1810 (Palermo).
Thynnus sardus Risso, "Eur. Mérid., iii, 417, 1826."
Sarda pelamys Gill, Rept. U. S. Fish Com., 802, 1872 (Boston Market); Baird, Rept. U. S. Fish Com., 825, 1872 (Holmes's Hole); Bean, Proc. U. S. Nat. Mus., 89, 1880 (Noank, Conn.; mouth Potomac River).

Sarda mediterranea Jordan & Gilbert, Synop. Fish. N. A., 427, 1883; Goode, Nat. Hist. Aquat. Anim., 316, pl. 92, 1884 (Wood's Holl); Jordan & Gilbert, Proc. U. S. Nat. Mus., 19, 1884.

Habitat.—Coasts of America and Europe; Cape Cod to Cape of Good Hope. The specimen examined by us is from Wood's Holl.

Etymology: *σάρδα*, the Greek name, from Sardinia.

This species seems to inhabit the open ocean, approaching the shores for food or for the purpose of spawning. It reaches a length of 2½ to 3 feet and a weight of 10 to 12 pounds. It is a fair food-fish, but not of fine quality.

10. SARDA CHILENSIS.

(CALIFORNIA BONITO, SKIP-JACK, TUNA.)

Pelamys chilensis Cuv. & Val., viii, 1831, p. 163 (Valparaiso); Günther, ii, 1860, p. 368; Steindachner, Ichthyologische Notizen, vii, 25, 1868.

Sarda chilensis Jordan & Gilbert, Proc. U. S. Nat. Mus., iii, 1880, p. 27 (San Diego, Cal.), no description; Jordan & Gilbert, Proc. U. S. Nat. Mus., iii, 1880, p. 456 (Monterey Bay, San Pedro), no description; Jordan & Jouy, Proc. U. S. Nat. Mus., iv, 1881, p. 12 (San Diego, Cal.), no description; Jordan & Gilbert, Proc. U. S. Nat. Mus., iv, 1881, p. 45; Jordan & Gilbert, Syn. Fish. N. A., 1882, p. 428; Jordan, Nat. Hist. Aquat. Anim., 1884, p. 319 (California).

Pelamys orientalis Temminck & Schlegel, "Fauna Japan, Poiss., 1850, p. 99, pl. 52" (Japan); Günther, ii, 1860, p. 368; Steindachner, Ichthyologische Beiträge, iv, 11, 1875 (Panama).

Pelamys lineolata Girard, U. S. Pac. R. R. Exp., Fishes, 1857, p. 106 (San Diego, Cal.).

Sarda lineolata Lockington, Report Commissioners Fisheries California, 1879, p. 33 (Monterey Bay).

Sarda chilensis var. *orientalis* Steindachner & Döderlein, Beiträge zur Kenntniss der Fische Japan's, iii, 11, 1885 (Tokio).

Habitat.—Pacific Ocean; southern California to Japan and Chili. The specimens examined by us are from Santa Barbara.

Etymology: *chilensis*, living in Chili.

Dr. Steindachner regards the Japanese bonito (*S. orientalis*) as a variety of *S. chilensis*. It inhabits the open ocean, coming on the coast of California to spawn. Dr. Jordan says: "This fish is everywhere known as the bonito. The names 'Spanish mackerel,' 'Skip-jack,' and 'Tuna' are also sometimes applied to it. It reaches an average weight of about 12 pounds. It approaches to within half a mile of the shore, where it is taken in great numbers by trolling. It spawns in August or September. Its arrival is in early summer and its departure in the fall. As a food-fish it is not held in high esteem, the flesh being coarse."

Genus VII.—SCOMBEROMORUS.

Scomberomorus Lacépède, Hist. Nat. Poiss., iii, 292, 1802 (*plumierii = regalis*).

Cybium Cuvier, Règne Anim., 120, 1829 (*commersonii*).

Apodontis Bennett, Proc. Comm. Zoöl. Soc. I, 169, 1831 (*immunis*).

Lepidocybium Gill, Proc. Acad. Nat. Sci. Phila., 125, 1862 (*flavobrunneum*).

Chriomitra Lockington, Proc. Acad. Nat. Sci. Phila., 133, 1879 (*concolor*).

Scomberomorus Jordan & Gilbert, Proc. U. S. Nat. Mus., 573, 1882 (regalis).

Type: *Scomber regalis* Bloch = *Scomberomorus plumierii* Lacépède.

Etymology: σκόμβρος = mackerel; ὁμόρος, bordering on, near.

This genus contains numerous species which are more decidedly shore fishes than any of the others of the family, and consequently of narrower distribution. The name *Scomberomorus* must take the place of *Cybium*, the generic name heretofore most used by European authors.

ANALYSIS OF SPECIES OF SCOMBEROMORUS.

a. Gill-rakers rather long, slender, more than 8 below angle; dorsal spines 17 or 18; lateral line slightly wavy, descending obliquely.

b. Teeth small, slightly compressed, about 50 in each jaw; body comparatively little compressed; mouth oblique; gill-rakers long and slender, 18 below angle; premaxillary short, not reaching to posterior margin of eye; caudal peduncle nearly cylindrical; head a little depressed, about 5 in length; ventral fins short; pectorals inserted slightly above axis, and about 8 in length; depth of body equal to length of head. Color of the male dark steel-blue above, becoming silvery on sides; the female a shade lighter above, two rows of round bronze spots on sides equal to pupil. D. XVII–16–VIII; A. I, 16–VIII .... CONCOLOR, 11.

bb. Teeth strong, triangular, compressed; body somewhat compressed; gill-rakers long and slender, 8 to 12 below angle.

c. Color bluish above, silvery on sides and marked with many round bronze spots; no stripes on sides; head pointed, little compressed; teeth, 30 to 32 in each jaw; scales on base of pectorals; pectorals, about 5¼ in body; eye, 2 in snout; interdorsal space equal to the diameter of the eye; pectorals inserted a little above center of orbit; gill-rakers about 9 below angle. Head 4⅔; depth 5. D. XVIII–17–IX; A. II, 18–VIII .... MACULATUS, 12.

cc. Color silvery; sides with two black stripes crossing lateral line under soft dorsal, posteriorly broken up into irregular spots; snout somewhat convex in profile; lateral line wavy along the tail; teeth about 40 in each jaw; pectorals, 5½ in body; eye 2¼ in snout; interdorsal space less than half diameter of eye; pectorals inserted a little below the center of orbit; gill-rakers slender, about 11 below angle. Head 4¼; depth 4½. D. XVIII–16–VIII; A. II, 14–VIII .... REGALIS, 13.

aa. Gill-rakers short, thick, less than 8 below angle; dorsal spines 14 or 15; lateral line making an abrupt descent beneath soft dorsal; teeth large, compressed, about 30 in each jaw; anterior part of spinous dorsal without black blotch; pectorals 5 in body; eye 2 in snout; interdorsal space less than eye. Color of adult, iron gray, nearly or quite immaculate; young with yellowish spots. Head 5; depth 6. D. XV–15–VIII; A. II, 15–VIII .... CAVALLA, 14.

11. SCOMBEROMORUS CONCOLOR.

(MONTEREY MACKEREL.)

Chriomitra concolor Lockington, Proc. Acad. Nat. Sci. Phila., 1879, 133 (Monterey); Lockington, Report Cal. Fish Comm. (1878–'79), 1881, 34 (Monterey).

Scomberomorus concolor Jordan & Gilbert, Proc. U. S. Nat. Mus., 1880, 456 (Monterey; no description); Jordan & Jouy, Proc. U. S. Nat. Mus., 1881, 13 (Soquel, Cal.; no description); Jordan & Gilbert, Proc. U. S. Nat. Mus., 1881, 45 (Monterey Bay); Jordan & Gilbert, Syn. Fishes N. A., 1883, 425 (Monterey Bay); Jordan, Nat. Hist. Aquat. Anim., 1884, 316 (Monterey); Meek & Newland, Proc. Acad. Nat. Sci. Phila., 1884, 233 (Soquel).

abitat.—Monterey Bay. The specimen examined by us is from uel, Cal.

tymology: *con* and *color*, uniformly colored.

his species attains a length of about 2½ feet and a weight of 5 to unds. It has only been seen in Monterey Bay, where but a limited ber are taken each fall. Its flesh is of very fine flavor, and always gs a high price in the markets. They appear in September and ppear in November.

12. SCOMBEROMORUS MACULATUS.

(SPANISH MACKEREL.)

ber maculatus Mitchill, Trans. Lit. and Phil. Soc., i, 426, pl. 6, f. 8, 1815 (New York).

um maculatum Cuvier, Règne Anim., ed. 2, 121, 1829 (after Mitchill); Agassiz, Spix, Pisc. Brazil., 103, pl. 60, 1829 (Atlantic); Cuv. & Val., viii, 181, 1831 (New York); Storer, Bost. Jour., iv, 179, 1842 (Lynn, Mass.); Ayres, Bost. Jour. Nat. Hist., iv, 261, 1842 (Brookhaven); DeKay, New York Fauna, Fishes, 108, pl. 73, f. 232, 1842 (Long Island); Storer, Synopsis, 92, 1846; Baird, Fishes N. J. Coast, 21, 1855 (Beaseley's Point); Holbrook, "Ichth. South Carolina, 66, pl. 9, f. 1, 1855;" Günther, ii, 372, 1860; Günther, Fishes Central America, 388, 1866 (Belize; no description); Storer, Hist. Fish. Mass., 146, pl. 13, f. 1, 1867 (Lynn, Mass.); Gill, Rept. U. S. Fish Comm., 802, 1871–'72 (name only); Baird, Rept. U. S. Fish Comm., 825, 1871–'72 (Wood's Holl; no description); Gill, Cat. Fish., E. Coast N. A., 24, 1873 (name only); Poey, Proc. U. S. Nat. Mus., 4, 1878 (after Cuv. & Val.); Jordan & Gilbert, Proc. U. S. Nat. Mus., 375, 1875 (Albemarle Sound); Goode, Proc. U. S. Nat. Mus., 3, 1879 (Florida; no description); Goode & Bean, Proc. U. S. Nat. Mus., 128, 1879 (Pensacola); Goode & Bean, Fish., Essex Co., Mass., 15, 1879 (no description); Bean, Proc. U. S. Nat. Mus., 89, 1880 (Washington Market; no description); Ryder, Bull. U. S. Fish. Comm., 25, 1881; Earll, Bull. U. S. Fish Comm., 416, 1884 (Mobjack Bay); Smiley, Bull. U. S. Fish Comm., 74, 1885 (near Tampa Bay).

beromorus maculatus Jordan & Gilbert, Bull. U. S. Fish Comm., 106, 1882 (Mazatlan; no description); Jordan & Gilbert, Bull. U. S. Fish. Comm., 110, 1882 (Panama; no description); Goode & Bean, Proc. U. S. Nat. Mus., 237, 1882 (Gulf of Mexico); Jordan & Gilbert, Proc. U. S. Nat. Mus., 268, 1882 (Pensacola; no description); Jordan & Gilbert, Proc. U. S. Nat. Mus., 594, 1882 (Charleston, S. C.; no description); Jordan & Gilbert, Proc. U. S. Nat. Mus., 625, 1882 (Panama; no description); Jordan & Gilbert, Syn. Fish. N. A., 426, 1883; Bean, Cat. Fish. Ex. London, 51, 1883 (Charlotte Harbor; no description); Meek & Newland, Proc. Acad. Nat. Sci. Phila., 232, 1884; Goode, Nat. Hist. Aquat. Anim., 307, pl. 93, 1884; Jordan, Bull. U. S. Fish Comm., 78, 1884 (Key West; no description); Jordan, Proc. U. S. Nat. Mus., 373, 1885 (Mazatlan and Panama; no description); Page, Bull. U. S. Fish Comm., 406, 1886; Jordan, Proc. U. S. Nat. Mus., 27, 1886 (Beaufort; no description); Jordan, Proc. U. S. Nat. Mus., 36, 1886 (Key West).

bitat.—Warm seas of America; north to Lynn, Mass.; south to il, Panama, Mazatlan. The specimens examined by us are from Key t, Pensacola, and Washington Market.

ymology: *maculatus*, spotted.

is is one of the most valuable of our food-fishes, appearing in schools r Atlantic coast in greatly varying abundance. It reaches a weight or 9 pounds. It is found on the west coast of Mexico, where, ac- ing to Dr. Gilbert, it is held in low esteem as a food-fish.

13. SCOMBEROMORUS REGALIS.

(PINTADO, CERO, SIERRA.)

Scomber regalis Bloch, Ausl. Fische, pl. 333, 1793 (after a drawing by Plumier); Bloch & Schneider, Systema Nat., 22, 1801 (after Bloch); Jordan & Gilbert, Proc. U. S. Nat. Mus., 573, 1882.

Cybium regale Cuvier, Règne Animal, ed. 2, 121, 1829 (name only; after Bloch); Cuv. & Val., viii, 184, 1831 (San Domingo); DeKay, New York Fauna, Fishes, 108, 1842 (Gulf of Mexico); Günther, ii, 372, 1860 (Jamaica); Poey, Syn. Pisc. Cub., ii, 326, 1868 (Cuba); Gill, Rept. U. S. Fish Comm., 802, 1871–'72 (name only); Baird, Rept. U. S. Fish Comm., 825, 1871–'72 (Wood's Holl; no description); Gill, Cat. Fish. E. Coast N. A., 24, 1873 (name only); Poey, Enum. Pisc. Cubens., 73, 1875; Poey, Proc. U. S. Nat. Mus., 4, 1878 (Cuba); Goode, Proc. U. S. Nat. Mus., 3, 1879 (East Florida; no description).

Scomberomorus regalis Goode & Bean, Proc. U. S. Nat. Mus., 237, 1882; Jordan & Gilbert, Syn. Fish. N. A., 426, 1883 (Cape Cod to Brazil); Jordan, Proc. U. S. Nat. Mus., 120, 1884 (Key West); Jordan, Bull. U. S. Fish Comm., 78, 1884 (Key West; no description); Goode Nat. Hist. Aquat. Anim., 307, 316, pl. 94, f. 2, 1884 (Key West); Meek & Newland, Proc. Acad. Nat. Sci. Phila., 234, 1884 (Key West, Havana); Jordan, Proc. U. S. Nat. Mus., 36, 1886 (Havana); Jordan, Proc. U. S. Nat. Mus., 574, 1886 (West Indies; no description).

Scomberomorus plumieri Lacépède, iii, 292, 1802 (after Aubriet's copy of Plumier's drawings).

Cybium acervum Cuv. & Val., viii, 186, 1831 (in part; type); Poey, Repertorio, i, 322, 1867 and ii, 13 (Cuba); Poey, Enum. Pisc. Cubens., 73, 1875; Poey, Proc. U. S. Nat. Mus., 4, 1878 (no description).

Habitat.—East coast of America; Cape Cod to Brazil. The specimens examined by us are from Key West and Havana.

Etymology: *regalis*, kingly.

This species is closely allied to *maculatus*, from which most fishermen do not distinguish it. It attains a length of 5 or 6 feet and a weight of 20 or 30 pounds.

14. SCOMBEROMORUS CAVALLA.

(KING-FISH, SIERRA.)

Guarapucu Marcgrave, Hist. Brasil., 178, 1648 (Brazil).

Cybium cavalla Cuvier, Règne Animal, ed. 2, 121, 1829 (after Marcgrave); Tybring, Bull. U. S. Fish Comm., 150, 1886.

Cybium tritor Cuv. & Val., viii, 176, pl. 218, 1831 (West Coast of Africa); Günther, ii, 372, 1860 (after Cuv. & Val.).

Cybium caballa Cuv. & Val., viii, 187, 1831 (Brazil); Günther, ii, 373, 1860 (San Domingo); Guichenot, Sagra, Hist. Cuba Poiss., 103, 1850 (Cuba); Poey, Repertorio, i, 322, and ii, 13, 1867 (Cuba); Poey, Synopsis, 362, 1868; Poey, Enumeratio, 73, 1875 (Cuba); Poey, Proc. U. S. Nat. Mus., 3, 1879 (East Florida; no description); Poey, Bull. U. S. Fish Comm., 118, 1882 (Key West; no description).

Cybium immaculatum Cuv. & Val., viii, 191, 1831.

Scomberomorus caballa Goode & Bean, Proc. U. S. Nat. Mus., 237, 1882 (no description); Jordan & Gilbert, Proc. U. S. Nat. Mus., 268, 1882 (Pensacola); Jordan & Gilbert, Proc. U. S. Nat. Mus., 594, 1882 (Charleston; no description); Jordan & Gilbert, Syn. Fish. N. A., 427, 1883 (copied); Goode Nat. Hist. Aquat. Animals, 307, 316, pl. 94, f. 1, 1884 (Wood's Holl, Mass.).

Scomberomorus cavalla Jordan, Proc. U. S. Nat. Mus., 119, 1884 (Key West); Jordan, Bull. U. S. Fish Comm., 77, 1884 (Key West; no description); Meek & Newland, Proc. Acad. Nat. Sci. Phila., 235, 1884; Collins, Bull. U. S. Fish Comm., 359, 1885; Jordan, Cat. Fish. N. A., 68, 1885; Jordan, Proc. U. S. Nat. Mus., 36, 1886 (Havana; no description); Jordan, Proc. U. S. Nat. Mus., 574, 1886, (West Indies; no description).

Habitat.—Warm parts of the Atlantic; north to Wood's Holl; south to Cuba, Brazil, and west coast of Africa. The specimens examined by us are from Havana and Key West.

Etymology: The Spanish name, from *caballus*, a horse (horse-mackerel.) In the West Indies and about Florida it is one of the best food-fishes, reaching a large size and having flesh of excellent quality. It reaches a weight of 40 to 100 pounds, and a length of 3 to 5 feet.

We follow Meek & Newland in using the original orthography *cavalla*.

Genus VIII —ACANTHOCYBIUM.

Acanthocybium Gill, Proc. Acad. Nat. Sci. Phila., 125, 1862 (*sara*).

Type: *Cybium sara* Bennett = *Cybium solandri* Cuv. & Val.

Etymology: ἄκανθα = spine, κύβιον = the cured flesh of the pelamis, or the pelamis itself when at a particular age.

This remarkable genus indicates a long step from the type of *Scomberomorus* toward the type of the sword-fishes. The single species ranges widely in the warm seas.

ANALYSIS OF SPECIES OF ACANTHOCYBIUM.

a. Body elongate, fusiform; premaxillaries in front produced in a sort of beak, which is nearly half the length of the snout; teeth in jaws strong, serrated, enlarged posteriorly, about 50 in each jaw; corselet small; spinous dorsal very long; second dorsal and anal short and low; anal inserted behind the vertical from the soft dorsal; pectorals 2¼ in head; lateral line descending abruptly beneath the 16th spine. Color of back dark steel blue, paler underneath; indistinct vertical bands of young disappear with age. Head, 4; depth, 6¼. D. XXVI—12—VIII; A. 12—IX .... SOLANDRI, 15.

15. ACANTHOCYBIUM SOLANDRI.

(WAHOO, PETO.)

Cybium solandri Cuv. & Val., viii, 192, 1831.

Acanthocybium solandri Jordan, Proc. U. S. Nat. Mus., vii, 119, 1884 (Key West); Jordan, Bull. U. S. Fish. Comm., 77, 1884 (Key West; no description); Jordan, Cat. Fishes N. A., 68, 1885 (Cuba; Key West); Jordan, Proc. U. S. Nat. Mus., 574, 1886 (West Indies; no description); Jordan, Proc. U. S. Nat. Mus., 36, 1886 (Havana; no description).

Cybium sara Bennett, "Beechey's Voyage, Zool., 63, pl. 20, f. 2, 1849" (Loo-Choo); Günther, ii, 373, 1860 (after Bennett).

Cybium petus Poey, Memorias Cuba, ii, 234, tab. 16, f. 1, 1860 (Havana).

Acanthocybium petus Poey, Synopsis, 363, 1868; Poey, Enumeratio Pisc. Cubensis, 73, 1875; Poey, Proc. U. S. Nat. Mus., 5, 1878.

Cybium verany Döderlein, Giorn. di Sc. Nat. ed Econ., viii, 1872 (Palermo).

Habitat.—Tropical seas; north to Key West.

Etymology: SOLANDER, an early explorer.

This species is occasionally found about the Florida Keys, and is called by the fishermen of that region *Wahoo*, by the Cubans *Peto*. It reaches a length of 6 feet and a weight of over 50 pounds.

RECAPITULATION.

The following is a list of *Scombrinæ* recognized by us as occurring in the waters of America and Europe. The distribution, in general, of each species is indicated by the use of the following letters:

E. Europe.
I. Islands of Eastern Atlantic.
N. North Atlantic Coast, north of Cape Hatteras.
S. South Atlantic and Gulf Coast.
W. West Indies and Brazil.
C. Southern California.
P. Pacific Coast of Tropical America.
V. Pacific Coast of South America.

Family SCOMBRIDÆ.—Subfamily SCOMBRINÆ.

1. **Scomber** LINNÆUS.
    1. *Scomber scombrus* (Linnæus) E. N. (C.?)
    2. *Scomber colias* (Gmelin) I. N. C. P.
2. **Auxis** CUVIER.
    3. *Auxis thazard* (Lacépède) S. W. I. N.
3. **Orcynopsis** GILL.
    4. *Orcynopsis unicolor* (Geoffroy), E.
4. **Gymnosarda** GILL.
    5. *Gymnosarda pelamis* (Linnæus) W. N. E.
    6. *Gymnosarda alletterata* (Rafinesque) N. E. W.
5. **Albacora** JORDAN.
    § *Germo* Jordan.
    7. *Albacora alalonga* (Gmelin) C. E. V. W. N.
    § *Albacora.*
    8. *Albacora thynnus* (Linnæus) N. E. W.
6. **Sarda** CUVIER.
    9. *Sarda sarda* (Bloch) N. E.
    10. *Sarda chilensis* (Cuv. & Val.) C. V.
7. **Scomberomorus** LACÉPÈDE.
    11. *Scomberomorus concolor* (Lockington) C.
    12. *Scomberomorus maculatus* (Cuvier) N. S. C. W. P.
    13. *Scomberomorus regalis* (Bloch) W. S. N.
    14. *Scomberomorus cavalla* (Cuvier) S. W. N. E.
8. **Acanthocybium** GILL.
    15. *Acanthocybium solandri* (Cuv. & Val.) S. W. E.

64.—STATISTICS RESPECTING CERTAIN FEATURES OF THE VESSEL FISHERIES OF THE UNITED STATES.

[Prepared by the Division of Fisheries, J. W. Collins, in charge.]

INTRODUCTORY NOTE.

The statistical information presented herewith was prepared during the years 1886, 1887, and 1888, chiefly in response to requests from Congress, the Executive Departments, and the International Fisheries Commission. In several cases the tables have been modified somewhat and made more comprehensive than they were originally.

It is believed that the presentation of preliminary tables in this form (as distinct from the general fishery statistics of the years referred to), some of them being novel in arrangement and covering many branches and phases of the vessel fisheries, will furnish much that is valuable and instructive to all who are interested in the subjects considered. And also, while a clear conception may thus be gained of the matters dealt with, the peculiar and specific kind of information required by the executive and legislative branches of the Government will be apparent.

The data on which the tables are based were procured chiefly by special investigation and correspondence by the U. S. Fish Commission and by returns forwarded by collectors of customs on Treasury circular for obtaining statistics of the fisheries.

EXPLANATION OF TABLES.

Table I shows, by customs districts and States, the number and citizenship of men on vessels employed in the New England food-fish fisheries in 1886, including lobster and menhaden, but not including oyster and other shell-fish. The men engaged on lobster and menhaden vessels numbered 538; 515 of whom were Americans, 2 British provincials, and 21 other foreigners.

Table II relates to the vessels employed in the cod-fisheries that, during the year 1886, frequented grounds east of longitude 65° west. The fleets on each of the distant off-shore banks are enumerated; and the vessels carrying hand-lines or trawls, or both, are shown separately.

In Table III the vessels following the cod and halibut fisheries on off-shore grounds in 1886 are classified according to the localities in which the greater part of their catch was obtained, and also with reference to the kinds of bait used and the source of the bait supply. Each vessel is shown under the ground on which its principal fishing was done, thus explaining any apparent contradiction of Table II, which gives the fleets on the separate grounds. In winter, the vessels fishing for halibut, and those engaged in the cod-fishery on George's, Brown's, La Have, and Western banks, usually take supplies of frozen-herring bait from the home ports.

Table IV shows the New England fleet engaged in the off-shore cod and halibut fisheries in the year 1888, dividing them according to their hailing ports and fishing grounds. The total number of vessels is shown to have been 370, of which 305 were owned in the State of Massachusetts, 60 in Maine, and 5 in Connecticut. One hundred and two of the vessels fished exclusively on the Grand Bank, and 63 others visited that ground at some period in the year.

Table V gives the number of American fishing vessels entering British North American ports, including those of Newfoundland, together with the number of times said ports were visited by the vessels in the several fisheries, and the amount of money expended by them for bait, ice, provisions, repairs, etc., during 1885, the last year of the continuance of the so called Washington treaty. In addition to the expenditures incurred on the part of the vessels, the crews disbursed greater or less amounts, aggregating $16,800, an estimate based on the assumption that each man would spend only $5 during the season. The average number of times that each vessel entered foreign ports in 1885 was five.

Table VI shows that in 1886 5,137 barrels of clam-bait, valued at $28,230, and in 1887 4,430 barrels, valued at $24,440, were shipped from Maine to be used by the provincials. Sedgwick, Deer Isle, and the vicinity of Portland are the centers of this trade. A large portion of the clam-bait received at Portland is transhipped by way of Boston, the custom-house records of which city show that in 1886 1,905 barrels, and in 1887 1,813 barrels, valued at $9,789 and $9,102, respectively, were exported to the provinces.

The mackerel fishery is treated of in four tables (VII to X).

Table VII shows, by customs districts, the quantity of mackerel caught by the New England fleet in 1886, with the fishing grounds on which the fish were taken. Three hundred and thirty-eight vessels used purse-seines; these schooners are generally of large size, ranging from 40 to 140 tons, and carrying from 10 to 20 men. The 149 vessels using hand-lines and nets vary in size from 5 to 70 tons, but are generally small craft, with from 2 to 13 men. They fished along the coast of the United States with more or less regularity during the summer months. Three fished in the Gulf of St. Lawrence with hand-lines; these were the schooners *M. L. Wetherell* and *William V. Hutchins*, of Gloucester, and *G. M. Hopkins*, of Provincetown.

The total catch of mackerel in 1886 was 130,170 barrels, of which 38,583 barrels were sold fresh and 91,587 barrels were brine-salted. The catch of the Southern fishery amounted to 19,812 barrels, of which all but 3,676 barrels were sold fresh, chiefly in New York. The New England shore yielded 39,303 barrels, of which 21,687 barrels were disposed of in a fresh state. The catch on the Nova Scotia shore and in the Gulf of St. Lawrence included more than half of the total product of the fleet, aggregating 71,055 barrels, of which 760 barrels were landed fresh in Portland. The vessels fishing with hand lines and nets secured 39 barrels of fresh mackerel and 27 barrels of salt mackerel in the Southern spring fishery; 3,357 barrels of fresh and 2,142 barrels of salt fish off the New England shore, and 191 barrels of salt mackerel in the Gulf of St. Lawrence. The total value of the mackerel taken by the fleet in 1886 was about $1,716,372.

The extent of the mackerel fishery in 1887 is given in Table VIII, which shows, in addition to the number of vessels and the catch, as set forth in Table VII, the aggregate tonnage and value of the vessels in each district, together with the number and citizenship of the men employed in the fishery and the value of the catch by districts. The table includes all vessels that during any portion of the year fished especially for mackerel. The mackerel catch of vessels not regularly engaged in the fishery is shown in a foot-note.

The extent of the American mackerel-fishery in the Gulf of St. Lawrence in 1887 is presented in Table IX. The average catch per vessel, only 98 barrels, is considerably less than half the average catch of vessels fishing on the American shore, which was 220 barrels in 1887. A list of the vessels, 178 in number, which entered the Gulf for mackerel, follows the table, the arrangement being alphabetical under ports.

The information contained in Table X was furnished by Messrs. D. L. Fernald & Co., of Portland. It shows the quantity and value of salt mackerel packed at Portland in 1887, with the percentage of same caught in the Gulf of St. Lawrence. The table includes all salt mackerel packed in Portland, regardless of where the vessels landing the fish were owned. The six packers handled 9,940 barrels, valued at $140,144.40; of which 2,198 barrels, valued at $26,407, were taken in the Gulf of St. Lawrence by 40 vessels that fished from six to twenty weeks in those waters; the average time being nine weeks, and the average catch 55 barrels.

In Tables XI, XII, and XIII the New England lobster-vessel fishery in 1887 is dealt with, the first table relating to Maine, the second to the other States having lobster fisheries, while the third is a condensed statement for the whole of New England. Reference to the tables, which give the statistics in great detail, shows, among other things, that Maine leads the other States in the number of vessels engaged in the fishery, the tonnage of same, the number of men employed, and the number and value of the lobsters transported; and that Connecticut is second to Maine in all these respects, and excels in the value of the vessels and outfits, and the number and value of the lobsters actually caught by the vessels' crews. The total output of this fishery was 1,960,939 lobsters, of which 639,294, valued at $49,908, were caught by the crews of the vessels; while the remaining 1,321,645, valued at $70,399, were caught by men fishing in small open boats along the shores adjacent to their homes, and were merely purchased by the vessels and transported by them to the city markets.

In Table XIV a comparative statement is furnished of the extent of the menhaden fishery in 1880 and 1886, the former figures obtained by agents of the U. S. Fish Commission for the Tenth Census, the latter by special field investigations of the Commission. Reference to the table discloses certain features of the fishery the mention of which will be of interest.

Number of factories.—The State having the largest number of factories, both in 1880 and 1886, is Virginia, 38 and 37 being the respective figures. A large proportion of the factories in 1880, however, were not in existence in 1886; many of those operating in the latter year representing new capital invested or a change in the location of plants.

Massachusetts, Rhode Island, Connecticut, New York, and New Jersey show a decrease in the number of factories, while whatever increase took place was south of New Jersey, and the increase was really more than can be judged from a bare statement of the number of factories, as is shown by the greatly augmented amount of capital invested in the Southern States. A noticeable impetus to the industry in the South, partially compensatory with its decline in the North, is seen in the number of works in 1886 in North Carolina, where in 1880 there were none.

Number of vessels.—Fewer steam and sail vessels were employed in 1886 than in 1880. Vessels of finer build, larger size, and with more men, however, made up for fewer numbers in 1886. While in 1880 the average value of steamers was $8,160, in 1886 it was $10,095. The value of sailing vessels shows a corresponding increase, the average in 1880 being $835 and in 1886 $1,425.

Number of men.—More men in the capacity of factory hands and fishermen were employed in 1886, notwithstanding the smaller number of factories and vessels.

Capital invested.—The total investment in 1880 was $2,061,654; in 1886 it was $2,921,632, or an increase of $859,978, made up chiefly of improved machinery and other shore property.

The yield of the fishery.—In 1886 the quantity of menhaden taken was less by 1,105,825 barrels, or about 368,608,000 fish, than in 1880. The yield of oil in the latter year was at the rate of 3 gallons to a thousand fish, and in 1886 averaged 5½ gallons; the actual increase in oil amounting to 914,878 gallons. The production of fertilizer was less in 1886 than in 1880 by 27,281 tons. The total value of the output of the fishery was $2,116,787 in 1880 and $1,517,330 in 1886; the decrease in the latter year being $599,457.

Table XV shows the average quantity of fish taken per vessel and per man, for the years 1879, 1880, 1885, 1886, 1887, and 1888, of 20 vessels belonging at ports in the State of Maine, and employed in the cod fisheries of Quereau, Western, and Grand banks.

Tables XVI to XX give comparative statistics for several different years of the operations of vessels hailing from New England ports and engaged in the cod or the market fisheries.

Table XVI shows the average catch per vessel and per man, for the years 1879, 1885, 1886, 1887, and 1888, of 20 Gloucester vessels engaged in the George's cod-fishery, and 20 others in the Grand, Western, and Quereau banks cod-fishery. The figures given show that the catch of the average bank vessel was from 7,000 to 40,000 pounds larger in 1888 than in 1879, and the catch per man had increased during the same period by from 1,000 to 4,000 pounds, except in the George's cod-fishery, where there was a falling off of 1,265 pounds in that particular. The cod-fishery seems to have been most successful in 1886 on George's Bank, while on the other banks, although the increase in the quantity taken by each vessel is most marked for 1887 and 1888, the catch per man was largest in 1885.

Table XVII shows the average annual catch per vessel and per man, from the years 1885 to 1888, of 14 vessels belonging to Provincetown, Massachusetts, and employed in the cod-fisheries on Quereau, Western, and Grand banks. The figures given show that the average catch of each vessel in 1887 was 8,350 pounds greater than in 1885, and the average to each man had increased by 816 pounds during the same period; but the year 1888 was a less fortunate one, and the averages were 4,205 pounds to a vessel and 2,722 pounds to a man below what they had been in 1885. The apparent disproportion between the decrease per vessel and per man is due to the fact that the crews carried in 1888 numbered more men than in 1885.

Table XVIII shows the American cod-fishery in the Gulf of St. Lawrence between 1885 and 1888, inclusive. For a number of years the only American vessels entering the Gulf of St. Lawrence for the purpose of taking fish other than mackerel have belonged at the port of Provincetown, and these have fished only for cod, chiefly with trawls. It will be seen from the table that the average catch of these vessels in so-called Canadian waters is very much less than the catch of other vessels following the cod-fishery on the ocean banks.

Table XIX shows the largest catch of a single vessel and average catch and stock of 20 vessels of the fleet engaged in the Boston market fishery between 1885 and 1888, inclusive. The catch consists of cod, haddock, pollock, etc., and is marketed fresh in Boston. The Boston market schooners are among the finest and largest of the New England fishing fleet, and are specially noted for speed. Their average net tonnage is 84.45 tons, and the average number of men constituting a crew is 17.

Table XX shows the largest individual catch and the average catch and stock of 16 vessels, chiefly welled smacks, engaged in the market fishery from the port of Greenport, New York, taking chiefly cod and bluefish, with trawls and hand-lines, and landing their catch in New

York City. The average tonnage of the vessels is 43.33 net, and 9 men constitute the average crew.

Table XXI shows the vessel fishery for the year 1887, of the customs district of Philadelphia, comprising the ports of Philadelphia, Pa., and Camden, N. J. Oystering is the most important fishery interest of the district, 77 vessels out of the entire fleet of 90 vessels being engaged in the oyster fishery, while 4 other vessels followed both fishing and oystering. Four vessels fishing only and 5 transporting fish complete the enumeration. The vessels had an aggregate value of $184,651, including apparatus and outfit, and carried 515 men. The value of the fishery products taken and transported was $335,179, of which $264,029 represented oysters and $71,150 fish.

TABLE L.—*Number and nationality of men on vessels employed in New England food-fisheries in 1886.*

Customs district.	American citizens.	British provincials.	Other foreigners.	Total number of men on vessels.	Percentage of American citizens.	Percentage of British provincials.	Percentage of other foreigners.
MAINE.							
Passamaquoddy	93	34	....	127	73.0	27.0	....
Machias	81	....	....	81	100.0	....	....
Frenchman's Bay	310	43	4	357	87.0	12.0	1.0
Castine	429	42	....	471	91.0	9.0	....
Bangor	4	....	....	4	100.0	....	....
Belfast	352	4	....	356	99.0	1.0	....
Waldoborough	438	4	....	442	99.0	1.0	....
Wiscasset	300	113	....	413	73.0	27.0	....
Bath	26	1	....	27	96.0	4.0	....
Portland	1,211	151	15	1,377	89.0	10.0	1.0
Saco	24	1	....	25	96.0	....	4.0
Kennebunk	60	....	....	60	100.0	....	....
York	11	....	....	11	100.0	....	....
Total	3,339	393	19	3,751	89.0	10.5	.5
NEW HAMPSHIRE.							
Portsmouth	130	12	4	146	89.0	8.0	3.0
MASSACHUSETTS.							
Newburyport	49	4	....	53	92.0	8.0	....
Gloucester	3,365	1,102	726	5,193	65.0	21.0	14.0
Salem and Beverly	113	26	....	139	81.0	19.0	....
Marblehead	251	2	2	255	98.0	1.0	1.0
Boston	569	106	84	759	75.0	14.0	11.0
Plymouth	58	3	....	61	95.0	5.0	....
Barnstable	940	604	869	2,413	39.0	25.0	36.0
Nantucket	14	....	....	14	100.0	....	....
Edgartown	25	....	....	25	100.0	....	....
New Bedford	78	....	25	103	76.0	....	24.0
Total	5,462	1,847	1,706	9,015	60.6	20.5	18.9
RHODE ISLAND.							
Newport	341	....	....	341	100.0	....	....
Bristol and Warren	6	....	....	6	100.0	....	....
Providence	22	2	....	24	83.0	17.0	....
Total	369	2	....	371	99.5	.5	....
CONNECTICUT.							
Stonington	284	....	17	301	94.0	....	6.0
New London	297	....	49	346	86.0	....	14.0
New Haven	8	....	....	8	100.0	....	....
Total	589	....	66	655	89.9	....	10.1
Grand total	9,889	2,254	1,795	13,938	70.9	16.2	12.9

TABLE II.—*The New England cod fleet fishing east of longitude* 65° *west in* 1886.

Locality where fishing.	Vessels carrying hand-lines only.	Vessels carrying trawls only.	Vessels carrying both hand-lines and trawls.	Total.
A. Vessels fishing for cod only:				
Grand Bank exclusively	47	9		56
Grand and Western banks	5	4		9
Grand Bank and banks west of longitude 65° W.			2	2
Western Banks exclusively	49	3	2	54
Western Banks and banks west of longitude 65° W	74			74
Total	175	16	4	195
B. Vessels employed in cod and other fisheries during the year, but when in the cod-fishery, at times fishing east of longitude 65° W.:				
Grand Bank exclusively		6		6
Grand and Western banks	1	7	3	11
Grand Banks and banks west of longitude 65° W	1	6		7
Western Bank exclusively	15	2		17
Western Banks and banks west of longitude 65° W	6	4	3	13
Total	23	25	6	54

NOTE.—Vessels mentioned as having fished a portion of the year west of longitude 65° west are those which engaged for a short time in either the market fishery or the so-called George's cod-fishery. The term Western Banks should, in every case, be understood to include not only Western Bank proper, but also Quereau and La Have.

TABLE III.—*The New England off-shore cod and halibut fleets in* 1886, *classified according to fishing-grounds and bait supply.*

Fishery.	Fishing-grounds.	Vessels.	Fresh bait.	
			Kinds used.	Whence obtained.
Cod	Grand Bank	95	Herring, capelin, mackerel, and squid, and occasionally Bank clams, cod-roe, birds, and porpoise.	Chiefly Newfoundland; also New England and Nova Scotia occasionally on banks.
Do.	Quereau and Western banks.	80	Herring, mackerel, and squid.	New England, Nova Scotia, and occasionally New Brunswick.
Do.	George's and Brown's banks.	180	Herring, alewives, menhaden, mackerel, and squid.	New England, New Brunswick, Nova Scotia, and occasionally Long Island, N. Y.
Halibut	La Have, Western, Quereau, Grand, Green, and St. Pierre banks.	55	Herring, mackerel, cod, haddock, and refuse fish taken on trawls.	Chiefly New England, but sometimes Nova Scotia for first days of fishing; afterwards on banks.
Do.	Off Greenland and Iceland.	6	Chiefly halibut, but also cod and refuse fish taken on trawls.	Caught by crew.

Fishery.	Fishing-grounds.	Vessels.	Salt bait.	
			Proportion of the vessels using salt bait.	Kinds used.
Cod	Grand Bank	95	Three-fifths	Squid and clams; occasionally herring and capelin.
Do.	Quereau and Western banks.	80	One-half	Squid and clams.
Do.	George's and Brown's banks.	180	None	
Halibut	La Have, Western, Quereau, Grand, Green, and St. Pierre banks.	55	...do	
Do.	Off Greenland and Iceland.	6	All for first two or three days fishing.	Chiefly herring.

NOTE.—Bait such as bank clams, cod-roe, birds, halibut, porpoises, etc., obtained on the banks, is usually called "shack," and the capture of fish with such lures is denominated "shack fishing." Squid, capelin, or herring taken in quantities on the banks are not included among the material known as shack.

TABLE IV.—*Off-shore vessel fleet of New England in 1888, by hailing ports and fishing-grounds.*

Customs district.	Fisheries in which the vessels are employed.	Grand Bank only.	Grand Bank and other banks east of Cape Sable.	Grand Bank and banks west of Cape Sable.	Banks east of Cape Sable, excluding the Grand Bank.	Banks west of Cape Sable.	Both on banks east and west of Cape Sable, excluding the Grand Bank.	Total number of vessels fishing on Grand Bank.	Total number of vessels engaged in off-shore bank fisheries.
Frenchman's Bay	Cod	11			1			11	12
Castine	do	16						16	16
Belfast	do				1				1
Waldoborough	do				2				2
Wiscasset	do				15		1		16
Portland	do				13				13
	Total for Maine	27			32		1	27	60
Gloucester	Cod	15	20	27	14	92	30	62	198
	Halibut	13	7	1	*6	1		21	28
	Cod and halibut		5		1	3	1	5	10
	Total	28	32	28	21	96	31	88	236
Salem and Beverly	Cod	3				1		3	4
Marblehead	do					1			1
Boston	do					2	1		3
	Cod and halibut					1			1
	Total					3	1		4
Barnstable	Cod	44	3		3	4	1	47	55
	Cod and halibut					4			4
	Total	44	3		3	8	1	47	59
New Bedford	Cod				1				1
	do	62	23	27	18	100	32	112	262
	Halibut	13	7	1	6	1		21	28
	Cod and halibut		5		1	8	1	5	15
	Total for Massachusetts	75	35	28	25	109	33	138	305
Stonington	Halibut					1			1
New London	do					3	1		4
	Total for Connecticut					4	1		5
	Cod	89	23	27	50	100	33	139	322
	Halibut	13	7	1	6	5	1	21	33
	Cod and halibut		5		1	8	1	5	15
	Grand total	102	35	28	57	113	35	165	370

* Iceland.

TABLE V.—*Transactions of American fishing vessels in foreign ports in 1885.*

State and district.	Number of vessels entering foreign ports.				Number of times entering foreign ports.				Amounts expended.				
	In cod fishery.	In mackerel fishery.	In halibut and other fishery.	Total.	Cod vessels.	Mackerel vessels.	Halibut and other vessels.	Total.	For bait.	For ice.	For provisions and gear.	For repairs and other purposes.	Total.
Maine:													
Portland district	12	2	3	17	48	8	17	73	$690	$53	$376	315	$1, 434
Other districts	19	5	11	35	429	4	49	482	478	57	386	525	1, 446
Massachusetts:													
Gloucester	86	38	35	159	364	232	152	748	17, 153	2, 625	19, 557	14, 726	54, 061
Barnstable district	18	3		21	29	3		32	335	98	1, 161	976	2, 570
Other districts	6	1	1	8	15	3	5	23	563	167	889	1, 482	3, 111
Total	141	49	50	240	885	250	223	1,358	19, 219	3, 000	22, 379	18, 024	62, 622

TABLE VI.—*Exportation of clam-bait to the British Provinces.*

Place whence exported.	Barrels.		Value.	
	1886.	1887.	1886.	1887.
Sedgwick, Me	650	652	$3, 580	$3, 590
Deer Isle, Me	700	550	3, 850	3, 050
Portland, Me., and vicinity	3, 787	3, 228	20, 800	17, 800
Total	5, 137	4, 430	28, 230	24, 440

TABLE VII.—*The New England mackerel fishery in* 1886.

Customs district.	Number of vessels fishing with—		Southern spring fishery.		New England shore.		Nova Scotia shore and Gulf of St. Lawrence.	
	Purse seines.	Hooks, nets, and traps.	Sold fresh.	Brine-salted.	Sold fresh.	Brine-salted.	Sold fresh.	Brine-salted.
			Barrels.	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*	*Barrels.*
Passamaquoddy	1	....	145	....	100	73	....	364
Frenchman's Bay	3	4	....	....	91	232	....	....
Castine	9	1	445	130	125	1, 045	....	1, 545
Belfast	15	6	....	364	7	462	....	3, 015
Waldoborough	6	27	39	....	1, 348	821	....	500
Wiscasset	18	7	929	60	441	468	....	1, 418
Portland	45	4	4, 058	461	2, 417	3, 590	760	5, 888
Kennebunk	....	2	....	....	17	14	....	....
Portsmouth	4	1	200	....	1, 448	150	....	....
Newburyport	2	1	....	....	200	....	....	252
Gloucester	122	19	9, 250	770	2, 379	3, 510	....	48, 123
Salem and Beverly	....	1	....	....	7	....	....	....
Marblehead	13	1	....	....	6, 175	296	....	....
Boston	23	2	370	511	1, 944	1, 147	....	3, 083
Plymouth	2	1	....	8	1, 003	13	....	....
Barnstable	73	22	700	1, 369	2, 814	4, 546	....	6, 032
Nantucket	....	3	....	....	11	23	....	....
Edgartown	....	6	....	3	5	109	....	....
New Bedford	1	8	....	....	69	438	....	....
Newport	....	19	....	....	422	434	....	....
Providence	....	2	....	....	86	20	....	....
Stonington	....	8	....	....	519	2	....	....
New London	1	4	....	....	59	223	....	75
Total	338	149	16, 136	3, 676	21, 687	17, 616	760	70, 295

TABLE VIII.—*The New England mackerel fishery in* 1887.

Customs district.	Vessels.					Men.				Catch.		
	Using purse seines.	Using nets and hand-lines.	Net tonnage.	Value of vessels.	Value of apparatus and outfit.	Americans.	British provincials.	Other foreigners.	Total.	Sold fresh.	Brine-salted.	Value of catch.
MAINE.										*Bbls.*	*Bbls.*	
Passamaquoddy	1	....	92. 48	$8, 000	$2, 000	14	....	....	14	......	155	$1, 765
Frenchman's Bay	....	1	41. 00	3, 000	700	7	....	....	7	......	5	53
Castine	8	....	549. 98	25, 200	16, 200	103	21	...	124	......	2, 144	26, 839
Belfast	13	....	828. 07	37, 700	17, 830	156	33	2	191	66	1, 667	20, 941
Waldoborough	2	14	307. 19	25, 650	925	70	...	....	70	973	95	11, 539
Wiscasset	11	1	766. 80	57, 000	16, 300	149	21	....	170	629	2, 044	29, 084
Portland	36	10	3, 055. 19	210, 750	62, 770	550	57	18	625	3, 831	8, 058	150, 068
Kennebunk	....	1	6. 50	400	400	3	....	....	3	16	......	155
Total	71	27	5, 647. 21	367, 700	122, 125	1, 052	132	20	1, 204	5, 515	14, 168	240, 384
NEW HAMPSHIRE.												
Portsmouth	4	1	218. 40	14, 850	6, 325	44	4	2	50	805	248	9, 250
MASSACHUSETTS.												
Newburyport	1	1	57. 13	2, 600	2, 500	17	....	...	17	23	200	2, 250
Gloucester	132	33	10, 957. 12	656, 805	382, 490	1, 535	590	155	2, 280	10, 993	47, 171	625, 278
Salem and Beverly	...	3	36. 87	850	260	8	1	....	9	......	85	938
Marblehead	13	1	695. 48	46, 300	15, 600	165	3	....	168	6, 710	500	50, 722
Boston	16	6	1, 189. 17	73, 700	26, 425	164	58	44	266	2, 140	5, 287	69, 684
Plymouth	2	....	145. 37	7, 000	2, 700	26	....	..	26	268	60	3, 120
Barnstable	60	28	4, 863. 01	223, 000	92, 265	855	150	58	1, 063	4, 721	20, 896	272, 077
Nantucket	....	1	5. 34	400	65	3	....	....	3	6	15	340
Edgartown	....	5	70. 16	5, 800	1, 675	19	..	..	19	200	203	2, 243
New Bedford	1	11	158. 93	6, 650	1, 555	27	20	2	49	315	382	8, 570
Total	225	89	18, 178. 58	1, 023, 105	525, 535	2, 819	822	259	3, 900	25, 376	74, 799	1, 035, 222
RHODE ISLAND.												
Newport	....	17	189. 87	20, 900	610	53	....	....	53	179	1, 453	20, 563
Providence	....	1	10. 07	300	50	4	....	....	4	29	......	250
Total	....	18	199. 94	21, 200	660	57	..	...	57	208	1, 453	20, 813
CONNECTICUT.												
Stonington	....	2	32. 33	1, 700	400	6	....	....	6	204	......	1, 785
New London	1	4	135. 08	7, 550	2, 585	18	10	..	28	103	368	5, 132
Total	1	6	167. 41	9, 250	2, 985	24	10	...	34	307	368	6, 917
Grand total	301	141	24, 411. 54	1, 436, 105	657, 630	3, 996	968	281	5, 245	32, 211	91, 036	1, 312, 586

NOTE.—Twelve other vessels, including one in Connecticut, three in Massachusetts, and eight in Maine, took incidentally 53 barrels of fresh mackerel and 13 barrels of salt mackerel on the New England shore. These were valued at $531, and are not included in the above figures.

TABLE IX.—*The American mackerel fishery in the Gulf of St. Lawrence,* 1887.

District.	Vessels.	Net tonnage.	Mackerel taken.
			Barrels.
Portland district, Maine	*22	1, 782. 04	1, 101
Other districts in Maine	19	1, 381. 41	967
Gloucester district, Massachusetts	109	8, 722. 83	12, 976
Barnstable district, Massachusetts	†15	1, 163. 91	898
Other districts in Massachusetts	13	959. 95	1, 490
Total	178	14, 010. 14	17, 432

---

* Including one New York vessel fishing from Portland.

† Including one New London vessel fishing from Provincetown.

List of American mackerel vessels entering the Gulf of St. Lawrence in 1887.

Hailing port.	Name of vessel.	Tonnage.
Eastport, Me	Christina Ellsworth	92.48
Swan's Island, Me.	Augusta E. Herrick	94.61
	Daniel Simmons	66.27
	John Nye	63.58
	Robert Pettis	62.31
North Haven, Me	Alice C. Fox	59.10
	Amy Wixom	45.06
	Charles Haskell	62.34
	Eben Dale	55.09
	Electric Flash	78.09
	F. H. Smith	70.58
	Maud S	75.66
Vinal Haven, Me	Willie Parkman	73.85
Rockland, Me	Gracie C. Young	83.70
Booth Bay, Me	Ambrose H. Knight	87.04
	Caroline Vought	79.79
	Cora Louisa	74.50
Southport, Me	Fannie S. Orne	80.78
	Sir Knight	76.58
Portland, Me	Abbie M. Deering	96.25
	A. H. Lenox	68.88
	Eddie Pierce	91.05
	Elsie M. Smith	106.95
	Emma	77.04
	Ethel and Addie	86.02
	Fannie A. Spurling	81.53
	Fleetwood	53.19
	Francis M. Loring	73.20
	Gertie Lewis	68.63
	G. W. Brown	61.80
	Hattie Maud	86.82
	Henry Morganthau	85.53
	James Dyer	81.23
	John M. Plummer	95.65
	Josephine Swanton	57.70
	Lilla B. Fernald	78.36
	Lucy J. Warren	56.05
	Margaret S. Smith	109.13
	Mattie T. Dyer	103.48
	Solitaire	85.64
Newburyport, Mass	Sarah E. Babson	46.64
Gloucester, Mass	Ada R. Terry	65.83
	Albert H. Harding	61.11
	Alice C. Jordan	81.96
	A. M. Burnham	60.08
	Annie C. Hall	84.42
	Annie H. Frye	64.03
	A. R. Crittenden	81.35
	Argonaut	70.30
	Barracouta	65.15
	Bartie Pierce	90.15
	Belle A. Nauss	88.70
	Belle Franklin	75.96
	Blue Jacket	110.27
	Canopus	68.33
	Carrie E. Parsons	80.05
	Carrie W. Babson	85.86
	Charles C. Warren	103.43
	Col. J. H. French	79.03
	Commonwealth	81.23
	David A. Story	86.90
	David F. Law	57.73
	Edith Rowe	80.00
	Edward E. Webster	93.86
	Eleazar Boynton	84.53
	Electa A. Eaton	73.85
	Ellen M. Adams	85.81
	Enola C	62.02
	Ethel Maud	77.07
	Fannie Belle	80.21
	Fannie W. Freeman	90.10
	Farmer R. Walker	67.93
	Frank A. Radliffe	99.01
	Frank Foster	56.71
	Frederick Gerring, jr	67.34
	Frederick P. Frye	81.10
	Gatherer	90.92
	George Butler	87.87
	George F. Edmunds	141.80
	Gertie Evelyn	81.00
	G. P. Whitman	89.67
Gloucester, Mass	Harry G. French	95.16
	Hattie B. West	53.54
	Hattie L. Newman	93.43
	Hattie N. Woods	84.08
	Henry Dennis	91.55
	Henry Friend	64.02
	Henry Wilson	88.61
	Herald of the Morning	68.05
	Howard Holbrook	92.60
	Isaac A. Chapman	80.81
	James and Ella	85.75
	Jennie Seaverns	106.98
	John G. Whittier	99.10
	John S. McQuin	77.68
	John W. Bray	79.24
	Joseph Garland	48.87
	Knight Templar	69.60
	Lelia E. Norwood	74.39
	Leona	95.53
	Lizzie M. Center	77.04
	Lizzie W. Hannum	71.36
	Mabel Leighton	71.00
	Maggie and Lilly	77.72
	Margaret	44.24
	Martha C	75.20
	Mary Fernald	76.17
	Mary H. Thomas	93.08
	Mascot	77.06
	Matthew M. Murray	75.16
	Mattie Winship	73.44
	Maud M. Story	71.73
	Mayflower	108.18
	Molly Adams	117.26
	Moro Castle	84.41
	Nellie M. Davis	89.22
	Nellie N. Rowe	79.06
	Oresa	82.47
	Orient	89.07
	Ossipee	68.96
	Pendragon	68.47
	Phebe and Emma Small.	61.34
	Pioneer	62.88
	Porter S. Roberts	72.00
	Ralph E. Eaton	65.52
	Ralph F. Hodgdon	85.79
	Rapid Transit	80.25
	Rattler	78.59
	Richard Lester	69.08
	Robert J. Edwards	80.38
	Robin Hood	88.23
	Rushlight	63.63
	Sarah P. Ayer	67.81
	Sea Foam	54.99
	Senator Frye	85.14
	Senator Morgan	86.07
	Senator Saulsbury	102.38
	S. F. Maker	103.75
	Shiloh	81.68
	Starry Flag	56.53
	Vesta	75.70
	Volunteer	66.11
	Warren J. Crosby	107.90
	William D. Daisley	93.19
	William H. Foye	66.93
	William H. Jordan	86.00
	William H. Wellington.	81.35
	William M. Gaffney	70.92
	W. W. Rice	90.13
Rockport, Mass	Emma W. Brown	73.97
Swampscott, Mass.	Oscar and Hattie	81.28
	Paul and Essie	63.54
Boston, Mass	Andrew Burnham	86.37
	Charles H. Kelley	65.28
	Grover Cleveland	87.78
	Morning Star	76.43
	Neponset	69.84
	Roulette	79.15
	Sarah H. Prior	97.38

List of American mackerel vessels entering the Gulf of St. Lawrence in 1887—Continued.

Hailing port.	Name of vessel.	Tonnage.	Hailing port.	Name of vessel.	Tonnage.
Boston, Mass	Thetis	47.46	Wellfleet, Mass	Mary Steele	66.47
Cohasset, Mass	Charlotte	68.08	Provincetown, Mass.	Alice 1st	84.37
Plymouth, Mass	Hannah Coomer	90.72		Alice 2d	85.06
Wellfleet, Mass	Addie F. Cole	72.39		Gracie H. Benson	88.54
	Charles F. Atwood	66.33	Orleans, Mass	Hattie D. Linnell	80.27
	Eddie Davidson	77.98	Harwich, Mass	Charlotte Brown	79.33
	H. W. Pierce	70.22		Kate Florence	96.94
	Lizzie D. Barker	72.14	New London, Conn.	Frank Butler	70.85
	Lizzie Smith	73.35	New York, N. Y	Laura Belle	77.91
	Lucie M. Jenkins	69.67			

TABLE X.—*The pack of salt mackerel in Portland in* 1887.

Name of packer.	Total quantity of salt mackerel packed in Portland.							Portion caught in Gulf of St. Lawrence.			
	Total.		No. 1's (extra).	No. 1's.	No. 2's.	No. 3's (large).	No. 3's.	Vessels packing with these firms that entered the gulf.	Average time fishing in Gulf.	Mackerel taken in Gulf.	
	Bbls.	Value.								Bbls.	Value.
			Bbls.	*Bbls.*	*Bbls.*	*Bbls.*	*Bbls.*		*W'ks.*		
A. M. Smith	1,750	$25,294.40	240	478	451	203	378	6	8	107	$1,207.00
Lewis, Chase & Whitten	1,125	15,800.00	......	519	377	.....	229	5	6	145	1,800.00
C. D. Thomes	100	1,400.00	......	20	55	......	25	1	20	20	280.00
Charles A. Dyer	1,721	24,094.00	......	504	674	314	229	10	7	682	8,184.00
Green & Brower	1,004	14,196.00	145	364	381	16	98	1	8	12	156.00
D. L. Fernald & Co	4,240	59,360.00	......	1,333½	2,063½	393½	449½	17	6	1,232	14,780.00
Total	9,940	140,144.40	385	3,218½	4,001½	926½	1,408½	40	7	2,198	26,407.00

NOTE.—Two other firms, not included in the foregoing table, packed a few mackerel, but as they went out of business before the close of the season, it was impossible to get accurate statistics of their pack, which is estimated at about 200 barrels.

TABLE XI.—*The Maine vessel fishery for lobsters in 1887.*

Customs district.	Hailing port.	Vessels engaged in no other fisheries.				Vessels engaged part of the time in other fisheries.				Total lobster fleet.					Products.					
															Lobsters caught by crews of vessels.		Other lobsters transported by vessels.		Total.	
		Catching lobsters only.	Transporting lobsters only.	Both catching and transporting.	Total.	Catching lobsters only.	Transporting lobsters only.	Both catching and transporting.	Total.	Vessels.	Net tonnage.	Value of vessels.	Value of outfit.	Men.	Number.	Value.	Number.	Value.	Number.	Value.
Machias district, Me	Jonesport			2	2	2	1		3	5	49.56	$1,175	$560	16	28,567	$878	140,750	$2,224	169,317	$3,102
Frenchman's Bay district, Me	Gouldsborough							1	1	1	7.35	400	150	3	5,250	80	192,500	2,670	197,750	2,750
Castine district, Me	Castine					1			1	1	14.35	300	100	4	6,600	100			6,600	100
Belfast district, Me	North Haven					1			1	1	10.81	400	75	3	3,000	50			3,000	50
Waldoborough district, Me	St. George		1		1					1	28.59	600	50	2			43,636	3,491	43,636	3,491
	Cushing		4		4		1		1	5	88.58	2,800	600	11			321,041	17,802	321,041	17,802
	Rockland					1			1	1	9.54	400	200	3	4,000	160			4,000	160
	Friendship	1			1	1	2	2	5	6	162.23	8,600	900	23	82,651	1,776	68,801	3,495	151,452	5,271
	Bristol		2		2	1			1	3	53.01	3,100	300	7	4,000	160	138,375	10,825	142,375	10,985
	Waldoborough					1			1	1	7.58	125	200	4	10,000	700			10,000	700
	Damariscotta					1			1	1	5.85	400	50	2	4,000	300			4,000	300
	Total	1	7		8	5	3	2	10	18	355.38	16,025	2,300	52	104,651	3,096	571,853	35,613	676,504	38,709
Portland district, Me	Portland		3		3	1	3		4	7	140.74	4,225	600	16	4,088	286	315,986	21,758	320,074	22,044
	Harpswell		1		1					1	13.61	400	50	2			37,556	2,984	37,556	2,984
	Total		4		4	1	3		4	8	154.35	4,625	650	18	4,088	286	353,542	24,742	357,630	25,028
Saco district, Me	Saco	1			1					1	6.72	450	400	3	14,348	500			14,348	500
	Biddeford					1			1	1	8.75	800	220	9	60,000	4,800			60,000	4,800
	Total	1			1	1			1	2	15.47	1,250	620	12	74,348	5,300			74,348	5,300
Kennebunk district, Me	Cape Porpoise					2			2	2	17.24	550	300	7	7,700	380			7,700	380
	Total for Maine	2	11	2	15	13	7	3	23	38	624.54	24,725	4,755	115	234,204	10,170	1,258,645	65,249	1,492,849	75,419

TABLE XII.—*The Massachusetts, Rhode Island, and Connecticut vessel fishery for lobsters in 1887.*

Customs district.	Hailing port.	Vessels engaged in no other fisheries.				Vessels engaged part of the time in other fisheries.				Total lobster fleet.					Products.					
															Lobsters caught by crews of vessels.		Other lobsters transported by vessels.		Total.	
		Catching lobsters only.	Transporting only.	Both catching and transporting.	Total.	Catching lobsters only.	Transporting only.	Both catching and transporting.	Total.	Vessels.	Net tonnage.	Value of vessels.	Value of outfit.	Men.	Number.	Value.	Number.	Value.	Number.	Value.
Newburyport district, Mass	Newburyport	....	....	....	....	....	1	....	1	1	11.45	$300	$100	4	....	....	3,000	$150	3,000	$150
Gloucester district, Mass	Gloucester	....	....	....	....	1	....	....	1	1	11 63	600	350	3	3,500	250	....	....	3,500	250
Salem and Beverly district, Mass.	Salem	....	....	....	....	1	....	....	1	1	15.58	300	200	4	18,765	2,023	....	....	18,765	2,023
Marblehead district, Mass	Marblehead	....	....	....	....	1	....	....	1	1	12.05	500	100	4	3,500	300	....	....	3,500	300
	Swampscott	....	....	....	....	1	....	....	1	1	8.83	800	200	3	7,000	600	....	....	7,000	600
	Total	....	....	....	....	2	....	....	2	2	20.88	1,300	300	7	10,500	900	....	....	10,500	900
Boston district, Mass	Boston	2	....	....	2	1	....	....	1	3	52.07	2,250	450	13	25,291	1,770	....	....	25,291	1,770
New Bedford district, Mass	New Bedford	....	....	....	....	3	....	....	3	3	35.57	3,500	500	11	42,467	6,560	....	....	42,467	6,560
	Total for Massachusetts.	2	....	....	2	8	1	....	9	11	147.18	8,250	1,900	42	100,523	11,503	3,000	150	103,523	11,653
Newport district, R. I	Newport	1	....	....	1	....	....	....	....	1	11.33	1,200	300	4	11,000	1,100	....	....	11,000	1,100
Providence district, R. I	Providence	1	....	....	1	....	....	....	....	1	5.10	300	72	1	450	32	....	....	450	32
	Total for Rhode Island	2	....	....	2	....	....	....	....	2	16.43	1,500	372	5	11,450	1,132	....	....	11,450	1,132
Stonington district, Conn	Stonington	14	....	....	14	5	1	....	6	20	181.05	15,900	4,000	56	222,384	20,113	10,000	1,000	232,384	21,113
New London district, Conn	New London	1	....	1	2	2	....	....	2	4	81.56	11,700	1,500	16	70,733	6,990	50,000	4,000	120,733	10,990
	Total for Connecticut	15	....	1	16	7	1	....	8	24	262.61	27,600	5,500	72	293,117	27,103	60,000	5,000	353,117	32,103

TABLE XIII.—*The New England vessel fishery for lobsters in* 1887.

State.	Vessels engaged in no other fisheries.				Vessels engaged part of the time in other fisheries.			
	Catching lobsters only.	Transporting only.	Both catching and transporting.	Total.	Catching lobsters only.	Transporting only.	Both catching and transporting.	Total.
Maine	2	11	2	15	13	7	3	23
Massachusetts	2	....	....	2	8	1	....	9
Rhode Island	2	....	....	2	....	....	....	....
Connecticut	15	....	1	16	7	1	....	8
Total	21	11	3	35	28	9	3	40

State.	Total lobster fleet.				
	Vessels.	Net tonnage.	Value of vessels.	Value of outfit.	Men.
Maine	38	624.54	$24,725	$4,755	115
Massachusetts	11	147.18	8,250	1,900	42
Rhode Island	2	16.43	1,500	372	5
Connecticut	24	262.61	27,600	5,500	72
Total	75	1,050.76	62,075	12,527	234

State.	Products.					
	Lobsters caught by crews of vessels.		Other lobsters transported by vessels.		Total.	
	Number.	Value.	Number.	Value.	Number.	Value.
Maine	234,204	$10,170	1,258,645	$65,249	1,492,849	$75,419
Massachusetts	100,523	11,503	3,000	150	103,523	11,653
Rhode Island	11,450	1,132	....	....	11,450	1,132
Connecticut	293,117	27,103	60,000	5,000	353,117	32,103
Total	639,294	49,908	1,321,645	70,399	1,960,939	120,307

TABLE XIV.—*The menhaden fishery in 1886 compared with 1880.*

State.	Factories.	Fishermen.	Factory hands.	Total number of men.	Steamers.	
					Number.	Value.
Massachusetts:						
1880	1	251	20	271	*12	$97,500
1886	......	......	......	......	......	......
Rhode Island:						
1880	7	416	192	608	18	141,500
1886	3	291	178	469	13	156,500
Connecticut:						
1880	7	504	127	631	19	146,000
1886	5	152	102	254	7	63,000
New York:						
1880	26	756	325	1,081	30	270,000
1886	15	673	513	1,186	32	349,800
New Jersey:						
1880	12	174	130	304	1	3,000
1886	11	187	146	333	2	25,000
Delaware:						
1880	1	8	3	11	......	......
1886	2	30	70	100	2	20,000
Maryland:						
1880	1	15	6	21	......	......
1886	3	89	59	148	......	......
Virginia:						
1880	38	419	289	708	1	3,000
1886	37	1,045	605	1,650	9	48,500
North Carolina:						
1880	......	......	......	......	......	......
1886	6	252	83	335	2	13,600
Total:						
1880	93	2,543	1,092	3,635	81	661,000
1886	82	2,719	1,756	4,475	67	676,400

State.	Sail vessels.		Total capital invested.	Menhaden caught.	Oil made.	Scrap prepared.	Total value of products.
	Number.	Value.					
				Barrels.	*Gallons.*	*Tons.*	
Massachusetts:							
1880	*23	$8,900	$179,105	13,030	50,400	1,971	$61,769
1886	......	......	......	......	......	......	......
Rhode Island:							
1880	43	29,550	304,300	343,469	270,482	10,590	221,748
1886	6	4,500	393,780	245,727	661,334	5,620	253,364
Connecticut:							
1880	53	25,950	392,370	325,460	256,300	9,000	256,205
1886	8	3,050	163,480	66,440	134,878	1,933	70,755
New York:							
1880	117	121,750	819,990	1,444,456	1,186,682	32,210	1,114,158
1886	22	29,450	985,097	501,693	1,055,130	12,123	542,008
New Jersey:							
1880	30	32,400	129,250	145,323	87,747	4,545	146,286
1886	24	24,500	223,300	93,198	200,164	2,650	98,340
Delaware:							
1880	......	......	1,700	2,499	450	15	941
1886	......	......	116,850	98,886	298,880	2,875	116,750
Maryland:							
1880	3	2,900	12,775	19,515	10,575	300	11,85
1886	14	25,600	66,670	33,642	41,025	1,129	31,600
Virginia:							
1880	101	87,200	222,164	441,069	203,760	10,273	303,829
1886	148	238,500	863,615	523,623	512,623	13,861	355,500
North Carolina:							
1880	......	......	......	......	......	......	......
1886	26	26,800	108,840	65,787	77,240	1,432	49,013
Total:							
1880	370	308,650	2,061,654	2,734,821	2,066,396	68,904	2,116,787
1886	248	352,400	2,921,632	1,628,996	3,081,274	41,623	1,517,330

---

* These vessels were owned in Massachusetts, but the majority of them were engaged in fishing for *factories* in Rhode Island and New York.

TABLE XV.—*Average catch, by years, of vessels of Maine employed in the cod-fisheries on Quereau, Western, and Grand banks.*

Year.	Average catch per vessel.	Average catch per man.
	*Pounds.**	*Pounds.**
1879	136,701	10,278
1880	142,548	10,718
1885	225,660	15,780
1886	235,441	15,044
1887	237,030	15,441
1888	243,390	13,415

*These figures represent the weight of the fish after being dried for market.

TABLE XVI.—*Average catch, by years, of Gloucester vessels engaged in off-shore cod-fishery.*

Year.	George's cod-fishery.		Grand, Quereau, and Western banks cod-fishery.	
	Average catch per vessel.	Average catch per man.	Average catch per vessel.	Average catch per man.
	*Pounds.**	*Pounds.**	*Pounds.**	*Pounds.**
1879	236,182	22,073	235,444	17,904
1885	226,311	19,510	350,874	26,087
1886	282,065	23,328	322,879	23,569
1887	245,694	20,333	366,098	24,406
1888	247,967	20,808	374,251	22,308

*These figures represent the weight of the fish as landed by the vessels before being dried for market.

TABLE XVII.—*Average catch, by years, of vessels of Provincetown, Mass., employed in the cod-fisheries on Quereau, Western, and Grand banks.*

Year.	Average catch per vessel.	Average catch per man.
	*Pounds.**	*Pounds.**
1885	335,655	17,087
1886	331,635	17,196
1887	344,005	17,903
1888	331,450	15,365

*These figures represent the weight of the fish after being dried for market.

TABLE XVIII.—*American cod-fishery in the Gulf of St. Lawrence.*

Year.	Vessels.	Net tonnage.	Salt cod taken.	Value.
			Pounds.	
1885	5	300.58	544,320	$14,350
1886	2	127.97	250,880	6,800
1887	3	190.40	395,600	13,177
1888	3	190.40	316,760	12,000

TABLE XIX.—*Largest and average catch, by years, of vessels of Boston, Mass., engaged in the market fishery.*

Year.	Largest catch.	Average catch.	Average stock.
	Pounds.	*Pounds.*	
1885	1,465,000	782,775	$11,933
1886	1,534,000	864,737	11,329
1887	1,430,000	875,350	16,373
1888	1,560,000	907,683	16,965

TABLE XX.—*Largest and average catch, by years, of vessels of Greenport, N. Y., engaged in the market fishery.*

Year.	Largest catch.	Average catch.	Average stock.
	Pounds.	*Pounds.*	
1885	257,000	201,000	$7,782
1886	353,500	200,552	7,167
1887	284,770	185,037	6,807
1888	287,000	211,950	10,811

TABLE XXI.—*The vessel fishery of the Philadelphia customs district in 1887.*

	Number.	Net tonnage.	Value of vessels.	Value of apparatus and outfit.	Men.	Value of products.		
						Oysters.	Fish.	Total.
PHILADELPHIA, PA.								
Vessels oystering	48	1,140.63	$81,161	$11,365	271	$150,819	....	$150,819
Vessels fishing	4	112.12	7,600	2,100	43	....	$15,000	15,000
Vessels both oystering and fishing	4	122.31	13,850	1,550	37	19,000	10,200	29,200
Vessels transporting fish	...	....	....	....	....	....	....	....
Total	56	1,375.06	102,611	15,015	351	169,819	25,200	195,019
CAMDEN, N. J.								
Vessels oystering	29	626.49	59,400	3,675	150	94,210	....	94,210
Vessels fishing	...	....	....	....	....	....	....	....
Vessels both oystering and fishing	...	....	....	....	....	....	....	....
Vessels transporting fish	5	74.83	3,700	250	14	....	45,950	45,950
Total	34	701.32	63,100	3,925	164	94,210	45,950	140,160
TOTALS FOR DISTRICT.								
Vessels oystering	77	1,767.12	140,56	15,040	421	245,029	....	245,029
Vessels fishing	4	112.12	7,600	2,100	43	....	15,000	15,000
Vessels both oystering and fishing	4	122.31	13,850	1,550	37	19,000	10,200	29,200
Vessels transporting fish	5	74.83	3,700	250	14	....	45,950	45,950
Grand total	90	2,076.38	165,711	18,940	515	264,029	71,150	335,179

INDEX.

NOTE.—This index contains references to the entire volume; more detailed indexes to three papers will be found at the pages indicated.

	Page.
Bean, Tarleton H., Fishes of Great Egg Harbor Bay, New Jersey	153
Collins, J. W., Beam-trawl Fishery of Great Britain, etc	405
Earll and Smith, American Sardine Industry in 1886	191

A.

Page.

- *Abbie A. Snow*, schooner ... 76
- Acantharchus pomotis ... 132, 143
- Acanthocybium ... 445
  - analysis of ... 445
  - petus ... 445
  - solandri ... 445
    - habitat ... 446
- Achirus mollis ... 131, 134
- *Ada R. Terry*, schooner ... 66
- Ælurichthys marinus ... 130, 132, 150
- Agassiz, Alex ... 61
- Ala-longa ... 438
- *Alaska*, steamer ... 249, 250
- Albacora ... 437
  - alalonga ... 438
    - habitat ... 439
  - analysis of ... 438
  - thynnus ... 439
    - habitat ... 440
- Albacore ... 436, 438, 439
- *Albatross* operations ... 155
- Albemarle Sound, fisheries in ... 193
- *Albert H. Harding*, schooner ... 79
- Aldrich, A. W ... 29
- Alexander, W. B ... 197
- Algerian fishermen lost at sea ... 54
  - sea fisheries ... 51, 54, 55
- *Alice O. Jordan*, schooner ... 251
- *Alice M. Center*, schooner ... 246
- *Alice S. Hawkes*, schooner ... 251, 254
- Alilonghi ... 438
- Allen & Co., D ... 294
- Alpena whitefish distribution ... 64
- Alutera schœpfii ... 131, 134
- Alward and Eskritt ... 326
- American Angler cited ... 3
  - fish cultivated in England ... 17
  - fishing-vessels in foreign ports ... 454
  - sardine industry ... 161
- Amiurus natalis ... 132, 150
- Amphipoda ... 261
- Amsden, Mr ... 21

Page.

- Anderson, Sir James ... 6
- Anderson, John ... 43
- Anguilla rostrata ... 132, 151
- *Annie M. Jordan*, schooner ... 44, 77
- Annin, jr., James ... 21
- Anomalocera patersonii ... 261
  - occurrence of ... 260
- Ansell, Alfred W., quoted ... 295, 296, 298, 300
- Anthomyia sp ... 262
- Apeltes quadracus ... 132, 146
- Aphredoderus sayanus ... 132, 145
- Apodontis ... 441
- Apparatus for rearing fish-food ... 204
- Aquaria, cleaning of ... 280
  - feeding fish in ... 281
  - fish for ... 278
  - for biological research ... 235
  - management of ... 274, 277, 282
  - Mortimer ... 5
  - plants for ... 277
  - principles in management ... 275
  - stocking of ... 277
  - tank, construction of ... 275
- Aranea ... 262
- Archosargus probatocephalus ... 132, 142
- *A. R. Crittenden*, schooner ... 79
- Argyrosomus sisco ... 87
- *Arthur D. Story*, schooner ... 44
- Ashcroft, R. L., quoted ... 345
- Astroscopus anoplus ... 130, 131, 136
- Atkins, Charles G ... 29
- *Augusta E. Herrick*, schooner ... 227
- *Aurora*, vessel, hardships to ... 11
- Auxis ... 433
  - analysis of ... 433
  - bisus ... 434
  - rochei ... 434
  - tapeinosoma ... 434
  - taso ... 434
  - thazard ... 434
    - habitat ... 434
  - thynnoides ... 434
  - vulgaris ... 434

B.

Page.
B. A. Baker, schooner 75
Baird, Spencer F 2, 7, 65, 273, 440
Bairdiella chrysura 132, 141
Baker, F M 37
Baker's Falls and dam 421
Balænoptera 110
Balm of Gilead Brook, salmon planted in 411
Balsom, I. V 199
Banquereau fisheries 67, 69
Barren Island fisheries 67
Barrett, F. N 65
Batrachus tau 131, 135
Battery Station meteorological observations 96
  shad distribution 107
  hatching operations 95
Baum, S. C 197
Bay of Fundy fisheries 67, 69, 75, 80
Beam-trawl, description of 310
  fisheries 289, 390
Bean, Tarleton H 129, 216, 217, 226, 241
Beaufort, N. C., mullet industry 198
Beaver Meadow Brook, salmon planted in 412
Behr, E. von 21, 34
Belgian beam-trawl fishery 390
Bell, William A 39
Belle of the Bay, schooner 128
Berenger-Féraud 90
Bertherand, Dr 90, 91
Biological research, aid to 285, 286
Bird feathers, significance of 258
Birds, scarcity of 226, 257
Bissell, John H 7
Black bass, occurrence of 36
Blackfish for Pacific coast 50
Blackford, E. G 3, 7, 21, 108, 127
Bloater herring, preparation of 273
Boleichthys fusiforme 132, 144
Boleosoma olmstedi 132, 144
Bonito 436, 440
Booth, A 401
Boracic acid for preserving fish 41
  wholesomeness of 44
Borne, von dem 34
Boston as a fish market 403
Bothus maculatus 131, 135
Bradycellus rupestris 262
Brakeley, John H 20, 43
Breeze, sloop 76
Brevoortia tyrannus 132, 149, 253, 256
Brinkley, Mrs. L 194, 197
British Columbia, fish deposited in 25
  fisheries statistics 24, 25, 159
Brook, G 61
Brook trout, advantages of 39
  hybrid 216
  in Colorado 38
  England 19
Brown, J. E 44
Brown trout, advantages of 22
  assignment of 34
  distribution of 35
  growth of 21, 22
  in America 21

Page.
Brown trout, jumping of 21
  kinds of 21
Brown's Bank fisheries 75, 78, 80
Buckingham, R. H 35
Bugda River fisheries 121
Bulletin de la Société d'Acclimatation cited 207, 211
Burden, Henry 415, 417, 418
Buzzard's Bay fisheries 169

C.

Calanus 261
Calico bass in France 215
California bonito 441
  trout, occurrence of 38
Calliopius læviusculus 261
  occurrence of 260
Callorhynchus 60
Campbell, R. C 47
Canadian and Michigan fisheries, comparative cost of 9, 10
Canadian fish-breeding, cost of 8
  fisheries, report on 8
  value of 8, 9
  fishery service, cost of 9
Candace pectinata 261
Caranx hippos 131, 139
Carbonnier, Mr 212
Carcharias obscurus 132, 152
Care of living things 285
Caroline Vaught, schooner 74, 248
Carp, growth of 20
  in California 48
  Potomac River 44
  sale of 43
  sent to Mexico 43
Carr, T F Robertson, quoted 294, 370
Carrie E Parsons, schooner 231, 246, 247, 249, 250
Carroll, Captain 247
Carr's Brook, salmon planted in 410
Carthage, schooner 68
Cary chickens, occurrence of 258
Cashe's Bank fisheries 80
Catfish destroying salmon 56
Catostomus teres 132, 150
Cattran, Edward, cited 299
C. B. Manning, schooner 69, 76
Cedar River, salmon planted in 412
Central Station shad distribution 106
Centrarchus pomotis 129
Centropages hamatus 261
  typicus 261
  occurrence of 260
Centropristis furvus 132, 143, 256
Cephalacanthus volitans 131, 136
Cero 444
Cestracion 60
Cetaceans, scarcity of 257
Chabot-Karlen 207
Chætodon maculocinctus 131, 138
Chætognatha 261
Chætopoda 261
Chalker, Robert B 112
Chambers, W. Oldham 17, 39, 58

Page.
Chapman, H. C 286
Charlotte Harbor Bay mullet fishery 200
Chase, George F 233, 237, 248, 250, 258
Cheney, A. N 418
Chilomycterus fuliginosus 130, 131, 133
  geometricus 131, 132
Chimæra 60
Chironoma, reproduction of 208
Chriomitra 441
  concolor 442
Chromo, schooner 76
Chub mackerel 432
Classapuill trout 31
Ciscos, propagation of 37
Citharichthys 243, 245
  microstomus 131, 135
Clam-bait, exportation of 455
Clapham, Thomas 409
Clara Grimes, schooner 69
Clara S. Cameron, schooner 233, 237, 247, 248, 250
Clark, A. Howard 48
Clark, F. N 35, 64
Clathrocystis roseo-persicina 95
Clendon Brook, salmon planted in 413
Clione limacina 262
  occurrence of 260
Clupea æstivalis 132, 149, 245, 254
  mediocris 132, 149
  sapidissima 36
  vernalis 254
Cocks, Alfred Heneage 109
Codfish, eggs of 60
  buoyancy of 61
  development of 58
  hatching of 115
  fisheries 33
    catch of 463
    of France 51, 55
  growth of 118
  hatching in Norway 113
  poisoning, cause of 90
  reddening of 90
  roe, effect of temperature on 115
    specific gravity of 113
Cœlenterata 261
Cold Spring Harbor Station 409
Coleoptera 262
Col. J. H. French, schooner 248
Collins, D. E 217, 221
Collins, J. W 34, 127, 128, 218, 221, 226, 289, 447
Columbia River fisheries 47
  salmon canneries 42
Commonwealth, schooner 227
Concord, schooner 44
Conger conger 132, 150
Connecticut River shad statistics 112
  shad catch 112
Cooper, J. H 197
Coots, occurrence of 258
Copepoda 261
Coral fishery of Algeria 54
Coregonus albus 19
  in England 17
  artedi 37
Cormorants, occurrence of 258
Coryphænoides rupestris 243
Cottus 61
  octodecimspinosus 130, 131, 137, 246
Croatan Sound fisheries 193
Cromwell, Captain 249
Cruise on a British North Sea trawler 378
Crustacea 261
Ctenolabrus 61
  adspersus 131, 137
Ctenophora 261
Cumacea 261
Cybium 441
  acervum 444
  bonaparti 435
  caballa 444
  cavalla 444
  immaculatum 444
  maculatum 443
  petus 445
  regale 444
  sara 445
  solandri 445
  tritor 444
  verany 445
Cyclops food for fish 204
  habitat of 206
Cyclopterus lumpus 59, 245
Cynoscion regale 132, 140
Cyprinodon parvus 129
  variegatus 132, 148

D.

Dall, William H 217, 260
Dalrymple, G. H 29
Daniels, George C 195, 196
Daphnia as fish food 204, 207
  habitat of 206
  reproduction of 207, 208
David A. Osier, schooner 75
David A. Story, schooner 224
Davy Crockett, schooner 77
Day, Francis 32, 206, 298
Decapoda 262
Decker, Captain 250, 254
Deep-sea Fishing and Fishing-boats cited 293, 310, 312, 319, 320, 340, 389, 390
Deer Island fishing grounds 268
Delaware fish commission 44
Deleby Brook, salmon planted in 410
Delphinus, occurrence of 257
Denslow, Samuel 37
Dido, schooner 69
Diptera 262
Diseases of fish 281
Dixey, sloop 76
Dogfish, abundance of 254
Dopson, Mr 201
Dredging stations 157
Dresslar, Fletcher B 429
Drosophila 262
Druid, schooner 79
Ducks, abundance of 258
Duclos, Gilbert 215

Page.
Duff, R. W., cited 360
Duncan, W. A 3
Dunn, Horace D 49, 56
Dunnell, George R., quoted 326, 352
Durkee, John L 49
Du Roveray, Mr 207

E.

Earll, R. Edward 58, 161, 267
Eastport fishery industries 267
E. A. Williams, schooner 67, 75
Edinburgh, Duke of, quoted .. 296, 353, 356, 367, 368
Edith L. Conley, schooner 69, 75
Edith Rowe, schooner 222, 247
Edward E. Webster, schooner 234, 249
Eel in Westport River 33
Eggs of fishes 58
Elacate canada 130, 132, 144
Elasmobranchii 60
Eliza, schooner 67, 69, 75
Ella M. Adams, schooner 223
Elliott, James W 33
Elmore, Samuel 65
E. L. Sanborn, schooner 67
Elsie Smith, schooner 237, 250
Emma W. Brown, schooner 222
Emmons, John W 128
England, American fish cultivated in 17
Enneacanthus obesus 130, 132, 143
Eoff, Alex. Q 36
Epeira labyrintha 262
Ephomera, reproduction of 208
Erimyzon oblongus 132, 150
Erioptera 262
Eristalis transversus 262
Esox americanus 130, 132, 147
  reticulatus 132, 147
Estelle S. Nunan, schooner 67, 69
Etrumeus teres 132, 148
Eucinostomus argenteus 129
Euschistus variolaris 262
Euthynnus 435
  alliteratus 436
  pelamys 436

F.

Fairweather, Captain 16
Fannie Spurling, schooner 250
Farlow, W. G 95
Feddersen, Arthur 120
Feeder dam 422
Fenn, Apollos 38
Fernald, Captain 246, 251
Fernald & Co., D. L 449
Ferré, G 91
Fesler, Bert 429
Fowkes, J. Walter 217, 260
Finnen haddies, preparation of 273
Finwhale fishery 109
Firola 262
Fish-cars 48

Page.
Fish-culture in Italy 44
  on Pacific coast 49
Fish, disease of 281
  eggs of 58
  feeding of 281
  food for 207
  for aquaria 278
  notes on 243
  of Great Egg Harbor Bay 129, 131
  record of trials for 240
  size for planting 210, 211
Fish-eggs, buoyancy of 61
  depositing of 60
  development of 58
  successful packing of 18
  taking of 256
Fish food, cost of 214
  experiments with 209
  influence on young fish 210
  production of 205, 212
Fish Hawk meteorological observations ... 84, 85
  shad work 83. 86, 108
Fish, Henry C 237, 252, 253, 254
Fish Trades Gazette cited 363, 366
Fisheries injured by seals 81
  notes on 33
  of British Columbia 24
  the World cited 360
  statistics 159, 447
    an act concerning 25
Fisherman's Magazine cited 292
  Seamanship cited 299, 302, 303, 323, 334, 340
  vernacular 237
Fishery board for Scotland, report cited .. 294
  industries of Eastport 267
Fishing grounds, list of 297, 372
Fistularia tabaccaria 130, 132, 146
Flash, schooner 79
Flora Temple, schooner 67, 69
Florence Nightingale, schooner 75
Florida sponge fisheries 22
  sponges, description of 23
Food for young fish 18, 203, 207, 212
  of salmonidæ at sea 41
Fort Edward dam 421
  Miller dam 421
Fortune Bay fisheries 67, 69
Franklin Schenck, schooner 67
French beam-trawl fishery 388
  fisheries, statistics of 51, 55
    value of 51, 55
  fishermen lost at sea 54
  fresh-fish fisheries 53, 55
Frigate mackerel 434
Frozen-herring trade 267
Fry, Captain 251
Frye, A. D 22
Fundulus diaphanus 132, 148
  heteroclitus 132, 148
  luciæ 130, 132, 147
  majalis 132, 147
Furnessia, steamer 28

G.

Page.

- Gadus morrhua, 244
- Gammarus pulex, 204, 206, 212
  - reproduction of, 208
- Gannets, occurrence of, 258
- George's Bank fisheries, 67, 69, 75, 78, 80
- Geranomyia, 262
- German beam-trawl fishery, 398
- Germo, 437
- Germon, 438
- Gerres argenteus, 131, 138
- *Gertie Evelyn*, schooner, 228
- Glen Brook, salmon planted in, 411
- Glens Falls and dam, 422
- Gloucester fisheries, 66, 68, 73, 76, 78
- Glutinous hag, eggs of, 59
- Gobiosoma bosci, 131, 136
- Goniomyia, 262
- Goode, G. Brown, 373
- Goosefish, abundance of, 254
- *G. P. Whitman*, schooner, 228, 243
- *Grace Choate*, schooner, 69, 75
- *Gracie*, schooner, 76
- Gramm, Otto, 48
- *Grampus*, schooner, 67, 74
  - cruise, notes on, 241
    - to mackerel grounds, 217
  - orders to, 217, 218
- Grand Bank fisheries, 67, 69, 75, 78, 80
  - Manan herring fishery, 268
- Graves, W. S, 3
- Gravesend Bay, salmon taken in, 415
- Gray, J. E, 6
- Great Egg Harbor Bay fishes, 129, 131
  - Lakes, fisheries of, 7
  - Salt Lake, shad for, 108
- Grebes, occurrence of, 258
- Green, R. C, 271
- Greenleaf, Captain, 250
- Greenlow, Captain, 231
- Gremaz, piscicultural establishment at, 207
- *Grover Cleveland*, schooner, 250
- Guarapucu, 444
- Gulf Brook, salmon planted in, 412
- Gulls, occurrence of, 258
- Gymnosarda, 435
  - alletterata, 436
    - habitat, 436
  - analysis of, 435
  - pelamis, 436
    - habitat, 436

H.

- Haddock, abundance of, 273
  - fisheries, 273
  - fishing grounds, 273
  - supply of, 273
- Hagan, W. E, 417
- *Halcyon* shad work, 111
- Halibut, scarcity of, 79
- *Hamilton*, U. S. cruiser, 234
- Hamilton, W. R, 63
- Hamlen, William, 111
- Hansard, Dr. E. P, 55
- Haploidonotus grunniens, 63
- Harty, Captain, 238, 249, 250
- *Hattie Evelyn*, schooner, 237, 249
- *Hattie L. Newman* schooner, 249
- Hayden, Jabez H, 37
- *H. B. Hussey*, brig, 252
- Hellyer, Charles, quoted, 368
- Hemiptera, 262
- Hemirhamphus roberti, 132, 147
- Hemirhombus pætulus, 1
- Henderson Brothers, 28
- *Henry Morganthau*, schooner, 233, 248, 252, 266
- Herring, abundance of, 267, 270
  - fishery, 33, 267
    - of France, 52, 55
    - season of, 267
    - vessels employed in, 268
  - fishermen, wages of, 270
  - for pickling, supply of, 272
  - freezing of, 269
  - market for, 269, 270
  - nets, method of setting, 269
  - pickled, 272
  - shipment of, 271
- Heteropoda, 262
- Heteroptera, 262
- Hill, L. S, 29
- Hillier, George, 28
- Hinckelmann, Mr, 81
- Hippocampus, 59
  - punctulatus, 130, 131, 134
- Hippoglossoides, 243
- Hippoglossus vulgaris, 243
- Hodge, E. B, 29, 35
- Hokum Pond, salmon planted in, 412
- Holdsworth, Edmund W. H., quoted, 293, 294, 300, 307, 309, 311, 313, 329, 332, 333, 334, 341, 377, 389, 397
- Homoptera, 262
- Horse mackerel, 439
- Housatonic River shad statistics, 112
- *Howard Holbrook*, schooner, 227, 246
- Howietoun fish hatchery, 28
- Hudson River dams and obstructions, 420
  - pollutions of, 419
  - salmon planted in, 409
    - taken from, 415
  - shad for, 105
- Hughes, Atkins, 127
- Hydrargyra luciæ, 129
- Hydromedusæ, 261

I.

- Iceland fish hatcheries, 120
  - laws, 124
  - propagation in, 123
- fresh-water fisheries of, 120
- halibut fishery, 44
- salmon fishing apparatus, 123
- seal laws, 124
- Idotea irrorata, 261
  - occurrence of, 260
  - phosphorea, 261
  - robusta, 261

Page.
Imprisonment of fishes, effect on 286
Indian River, salmon planted in 412
Insecta 262
Isopoda 261
Israel J. Merritt, schooner 238, 249
Italy, fish culture in 44

J.

Jack, Edward 37
Jack salmon, occurrence of 36
Jackson, W. C. L 2
Jacksonville, Fla., mullet industry 198
Jacobs, Sol 232, 246, 247, 248, 251, 252
Jacobson, Herman 81, 90, 101, 207, 211
Jægers, occurrence of 258
Jan Mayen, wreck of 14
Japanese bonito 441
Jeffrey's Bank fisheries 80
Jerrell, H. P 51
Jex, Edward, cited 295, 369, 371
Joe Hooker, schooner 236, 250
Johanson, Nils 120
John G. Whittier, schooner 236, 248, 249
John S. McQuinn, schooner 246
John W. Bray, schooner 77
Johnson, A. C 417
Jones, Captain 254
Jordan, David S 37, 202
  cited 402
Joyce, Captain 223, 226, 248
Julia A., schooner 75, 76
Jutland, fisheries of 101
  method of fishing in 102, 104
J. W. Collins, schooner 79

K.

Kaeding, Charles 36, 48
Keene, Captain 227, 246
Kelso Brook, salmon planted in 412
Kemp, David 198
Kennebec River, shad planted in 16, 105
Kennedy, Matthew 416
King-crab for England 6
Kingfish 444
Kittiwakes, occurrence of 258

L.

Lacerto 432
Lagocephalus lævigatus 130, 131, 133
Lagodon rhomboides 132, 142
La Have Bank fisheries 69, 80
Lake herring, propagation of 37
  trout, hybrid 216
Lambert, Charles 34
Lamna cornubica 256
Lampris guttatus 202
Land birds on *Grampus* 258
  locked salmon for England 19
  locked salmon in England 18
Lapland finwhale fishery 109
Larbaletrier, Mr 211

Page.
Latham, Silas B 34
Layet, Alexandre 90
Lee, Thomas 155
Legal Tender, schooner 79
Le Lorrain, Jules, cited 390
Lepidocybium 441
Lewis, Eben 222
Lilla B. Fernald, schooner 246
Limnophila 262
Limulus 6
Liostomus xanthurus 132, 141
Literary and Philosophical Society of Liverpool cited 1
Little tunny 436
Live cars 48
Liverpool as a fish market 366
Lizzie Maud, schooner 233, 248
Lizzie W. Smith, schooner 234
Lobotes emarginatus 129
Lobster fishery statistics 459, 460, 461
Loch Leven, description of 32
  trout, characteristics of 32
    distribution of 29
    eggs, hatching of 30
      packing of 28
    in the United States 28
    planting of 29, 30
    pugnacity of 30
London as a fish market 366
Long, Mr 2
Long-finned albicore 438
Long Island Sound shad fisheries 112
Loon Lake, salmon planted in 412
Loons, occurrence of 258
Lophius piscatorius 243, 254
Lucania parva 132, 148
Lucket, J. F 44
Lugrin, F 203, 207
Lula Wilbur, schooner 246
Lumpsucker eggs, development of 59
Lutjanus 130
  blackfordii 2
  griseus 130, 132, 143

M.

McCormick, L. M 129
McDonald Fishway Company 420
McDonald, Marshall 35, 105
McElvane, Dr 201
McFarland, Captain 222
McGowan, Captain 246, 248
McIntire, Captain 223
McIntosh, Professor 58
McKay Captain 246
McKinnon, Captain 224
Mackerel, abundance of 231, 235
  fisheries 33
  fishery statistics 455, 456
  fleet 242
  food, character of 260
  food of 252
  grounds, investigation of 217
  miscellaneous notes on 251
  occurrence of 34, 128, 130, 246

Page.
Mackerel, reproduction of 252
review of 429
scarcity of 222, 223, 226, 228
size of 251
stomachs, contents of 259, 266
taken 222, 238
vessels, list of 457
Maine vessel fishery for lobsters 459
Maitland, J. R. Gibson 28, 31
Malanson, Captain 224
Malm, Dr 61
Manchester as a fish market 366
Manteo, fisheries at 193
Margaret S. Smith, schooner 231, 235, 247, 249
Mary H. Thomas, schooner 238, 250, 254
Mary S. Hontvet, schooner 67
Mary Story, schooner 75
Mason, Frank H 203
Mather, Fred 21, 28, 108, 409
Maud S., schooner 235, 247
Mayflower, schooner 224
Maynard, H. J 48, 55
Mechanicsville dam 420
salmon taken at 417
Meguin, Mr 91
Melanura pygmæa 132, 147
Melissa D. Robbins, schooner 229, 246
Menhaden, abundance of 237
fisheries, capital invested in 450
factories 450
men employed in 450
vessels employed in 450
yield of 450
fishery statistics 462
Oil and Guano Association 67
taken 224
Menidia laciniata 130, 132, 146
notata 132, 146
Menticirrus alburnus 132, 141
saxatilis 132, 141
Mesogonistius chætodon 130, 132, 143
Meteorological observations 98
record 84, 85
Mexico, carp for 43
M. H. Perkins, schooner 79
Michigan and Canadian fisheries, comparative cost of 9, 10
Miller, H. B 36
Minerva Brook, salmon planted in 412
Misumena americana 262
Mollie Adams, schooner 229, 232, 248
Mollusca 262
Monacanthus hispidus 131, 133
Moore, Thomas J 1
Mortimer, John H 2
Morehead City, N. C., mullet industry 198
Mosher A. A 30
Mowat, Thomas 24
M. S. Ayer schooner 230, 248, 249, 252, 253
Mudd, Harrison, quoted 295, 352
Mugil albula 132, 145
curema 132, 145
Mullet, artificial propagation of 197
diminution of 198, 199, 201
fisheries, investigation of 197
Page.
Mullet fishing season 198
migrations of 198, 201
occurrence of 201
spawning of 199, 200, 201, 202
Muntadas, F 211
Muscid 262
Mustelus canis 132, 152
Myliobatis fremenvillei 132, 151
Myxine glutinosa 59

N.

Nais, habitat of 206
Narragansett Bay, shad for 105
National Fish Culture Association Journal cited 17
Nauss, Captain 246
Neidlinger Philip 35
Nellie E. Rawson, steamer 234, 252, 253,
Nellie M. Davis, schooner 224, 227
Nemotelus 262
Neponset, schooner 230
Nets destroyed by seals 81
Newburgh Bay salmon taken in 418
New England fishery statistics 452, 453, 455, 456, 459, 460, 461
food fisheries, men employed in 452
Newfoundland herring trade 71
New York Bay, salmon taken in 415
Nilsen, S. A 110
North Creek, salmon planted in 411
Northville whitefish, distribution of 64
Norway, cod hatching in 118
Notemigonus chrysoleucus 132, 150
Novelty, steamer 223, 226, 229, 230
Nyctiphanes norvegica 262
Nye, jr., Willard 83, 160, 252

O.

Ocean King, schooner 68
Oceanic bonito 436
Ohio River, shad in 48
Olsen, O. T., quoted 298, 299, 302, 323, 334, 335
Oncorhynchus quinnat 65
Onos cimbrius 245
Opah, occurrence of 202
Ophidium marginatum 130, 131, 135
Opisthonema oglinum 130, 132, 149
Optimatus, schooner 76
Orca, occurrence of 257
Orcynopsis 434
unicolor 435
habitat 435
Orcynus 437
alalonga 438
albacora 439
alliteratus 436
argentivittatus 438
balteatus 438
germo 438
pacificus 438
pelamys 436
schlegelii 439

Page.

- Orcynus secundidorsalis 439
  - subulatus 439
  - thunnina 436
  - thynnus 439
- Oregon fish commission law 45
- Organisms, surface, list of 261, 263
  - notes on 259
- Orthopristis chrysopterus 130, 132, 142
- Osmerus 61
- *Ossipee* schooner 228
- Ostracoda 261
- Oxará River, fish planted in 122
- Oyster fisheries of France 53, 55

P.

- Pacetti, Bartolle 199
- Paden, R 3
- Palmer's Falls 422
- Pamlico Sound, fisheries in 193
- Paralichthys dentatus 131, 135
- *Paul*, schooner 77
- *Paul and Essie*, schooner 77
- Peacon, John 201
- *Peconic*, steamer 69
- Peirce, Milton P 43
- Pelamys 440
  - bonaparti 435
  - chilensis 441
  - lineolata 441
  - orientalis 441
  - sarda 440
  - unicolor 435
- Pendleton, W C 89
- Penicillium roseum 92
- Penobscot River, shad for 105
- Perch, croaking of 63
  - silver, in France 215
- Perry, Hamilton 3
- Peto 445
- Petrels, occurrence of 258
- Phalaropes, abundance of 231
  - occurrence of 221, 224, 227, 258
- *Phil Sheridan*, schooner 69
- Phycis 244
  - chuss 245
  - tenuis 245
- Pickled herring trade 272
- Piedra, piscicultural establishment at 211
- Pintado 444
- Plants for aquaria 277
- Pleurobrachia rhododactyla 261
- Pleuromma 261
- Pleuronectes americanus 131, 135
- Plimsoll, Samuel, quoted 349, 366
- Pneumatophorus 430
- Pogonias chromis 130, 132, 141
- Point Lepreaux fishing grounds 268
- Pollachius virens 244
- Pollock, abundance of 79
- Pomatomus saltatrix 132, 145, 253
- Pomotis chætodon 129
- Pond aquaria 286
- Poronotus triacanthus 131, 140, 253
- Porpoises, scarcity of 226
- *Porter S. Roberts*, schooner 236, 254

Page.

- Prince's Bay, salmon taken in 415
- Prionotus 245
  - palmipes 131, 136, 256
  - strigatus 131, 136
- Psyllobora 20-maculata 262
- Pteropoda 262
- Puffing pigs, occurrence of 257

Q.

- Quackenbos, John D 30
- Quereau Bank fisheries 80, 453, 454, 465
- Quinepiac River shad statistics 112

R.

- Raia eglanteria 132, 151
  - lævis 132, 151, 254
- Rainbow trout for England 19
  - in England 39
  - Missouri 55
  - Virginia 39
- *Ralph Hodgdon*, schooner 231, 247
- Rathbun, Richard 217, 252, 259
- Ravenel, W. de C 95, 197
- Raveret-Wattel, C 207
- Raymond Brook, salmon planted in 411
- Rays, eggs of 60
- Red codfish, cause of 91, 95
  - composits of 92
  - hygiene of 90
  - poisonous qualities of 94
- Redding, B. B 49
- Redding, Joseph D 57
- Red snapper, range of 34
- Reed F C 47
- Reniceps tiburo 130, 132, 152
- *Resolute*, steamer, destroyed 11
- Reynivellir fish hatchery 120
- *Rising Star* schooner 76
- Roanoke Island fishery 193
- Roaring Brook, salmon planted in 412
- *Robert J. Edwards*, schooner 225, 250, 254
- Roblee Brook salmon planted in 411
- Roccus americanus 132, 144
  - lineatus 35, 132, 144
- Rockfish for San Francisco Bay 50
  - industry 193
- Rockwell, Julius E 373
- Rockwell's Falls 422
- Rocky Mountain trout, disadvantages of 38
  - in Colorado 38
- Rogerson, James 251
- Rognerud, Carl 113
- Rowe, Sol 243, 245, 246, 254, 255
- Ruge, John G 22, 37
- Ryder, John A 63

S.

- Sacramento River salmon fisheries 57
- Sagitta 261
  - elegans 261
    - occurrence of 260
- Saibling, assignment of 34
  - distribution 35